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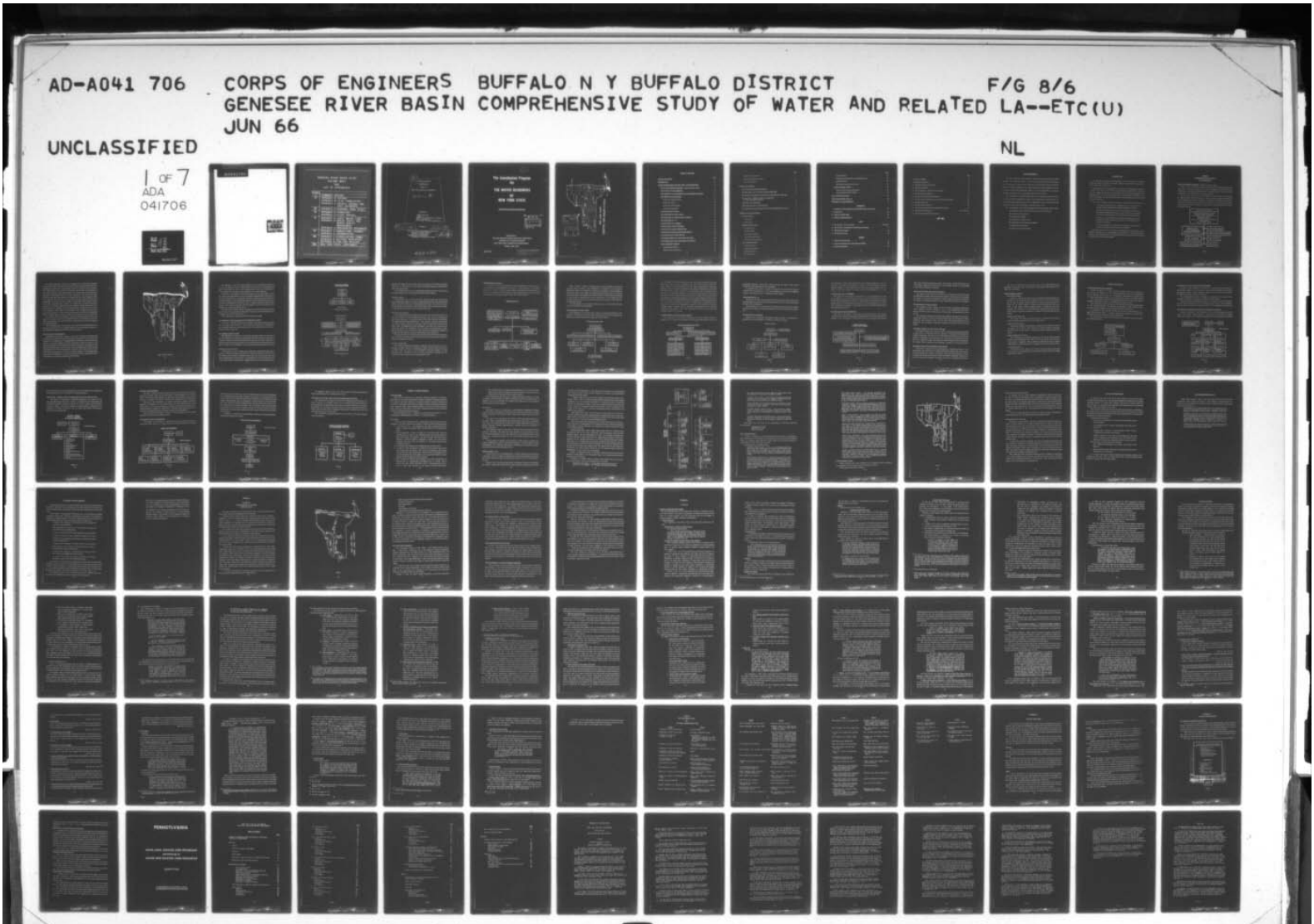

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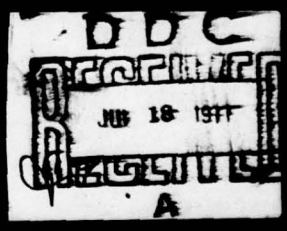

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GENESEE RIVER BASIN

COMPREHENSIVE

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WATER AND RELATED LAND RESOURCES.

Volume IV.

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(9) Final rept.

PREPARED BY

(11) Jun 66

NEW YORK STATE WATER RESOURCES COMMISSION
DIVISION OF WATER RESOURCES
CONSERVATION DEPARTMENT
COMMONWEALTH OF PENNSYLVANIA
DEPARTMENT OF FORESTS AND WATERS

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The Coordinated Program for THE WATER RESOURCES OF NEW YORK STATE

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ALBANY, NEW YORK

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Map A

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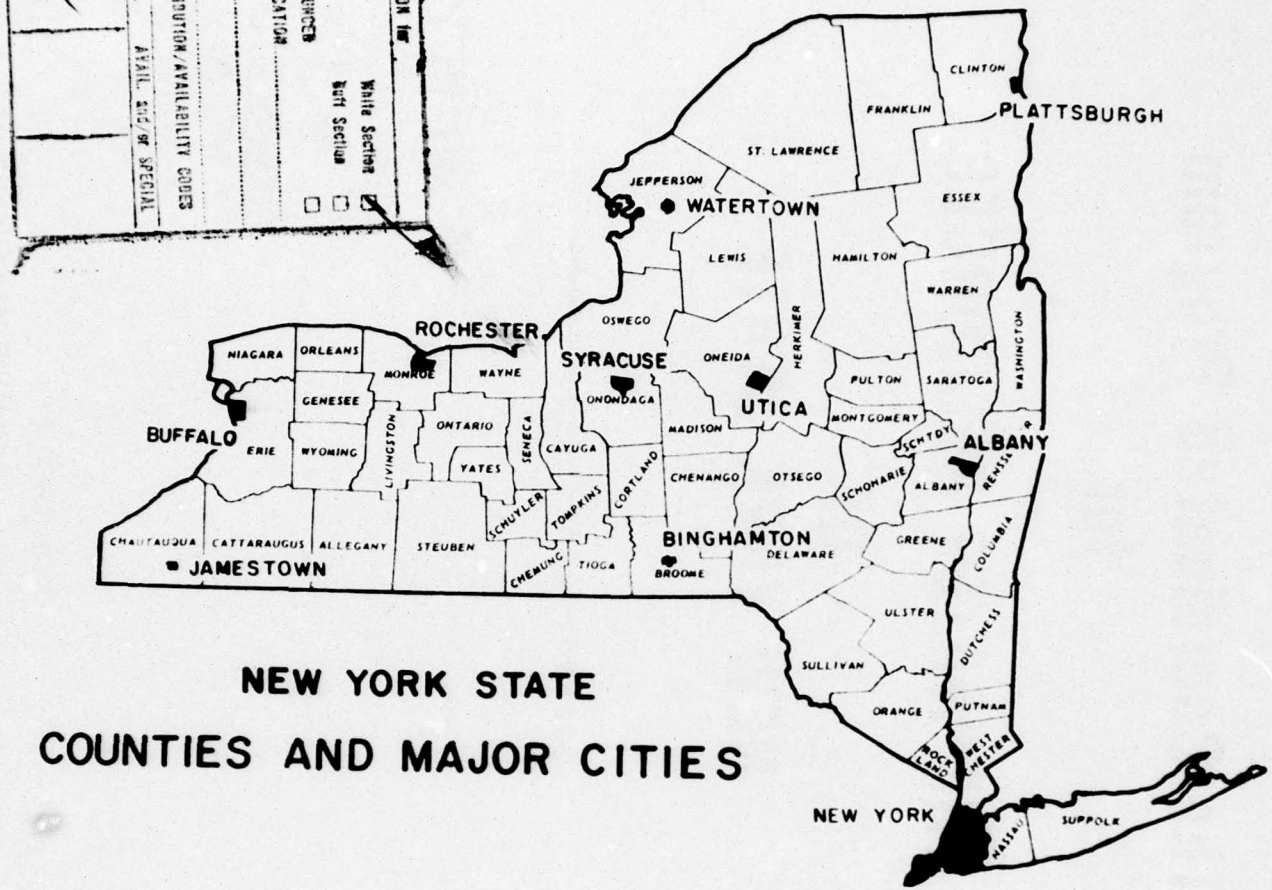

NEW YORK STATE
COUNTIES AND MAJOR CITIES

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ACKNOWLEDGEMENTS

The Water Resources Commission is grateful to those State agencies which furnished the information that is a large and important part of this compendium. Each of them has a share in New York State's current efforts to secure sufficient water of adequate quality for our needs during the next half century. The Water Resources Commission thanks these agencies for their contributions to a program that has no equal in service to the people of the State of New York.

The Commission is particularly grateful to the Division of Water Resources of the Conservation Department, which, as the Commission's staff arm, prepared and edited this compendium, and to the Department of Law, which prepared the summary of State Laws and carefully reviewed the entire work.

The contributions of the following agencies are also gratefully acknowledged:

The Temporary State Commission on Water Resources Planning

The Conservation Department

The Department of Health

The Department of Public Works

The Department of Agriculture and Markets

The Department of Commerce

The Office for Local Government

INTRODUCTION

The planning, development and management of water resources is a responsibility that must be shared by numerous agencies on all levels of government — local, county, state and federal.

The purpose of this compendium is to outline the administrative structure created by the State of New York to deal with these responsibilities. Appendix I (p. 39) outlines the history of New York's water resources development, while Appendix II (p. 44) cites the legal framework of the structure. Appendices III and IV (p. 76-78) outline the political subdivisions and special purpose districts dealing with water resources.

The major immediate goals of the State's Water Resources Program are:

To provide the basis for wise management of our water resources through scientific planning and equitable regulatory activities.

To establish comprehensive plans for multi-purpose development of the water and related land resources of each river basin and region of the State through regional and State-federal partnership efforts.

To work as a partner with federal agencies in formulating comprehensive plans that adequately reflect New York's interests in interstate river basins.

To fashion programs to implement regional plans for development of water resources as soon as they are established.

New York State now has the legal and administrative framework to achieve competent planning for the development and utilization of its water resources. However, actual development is a responsibility that must be appropriately assumed and shared by all levels of government.

AGENCIES RESPONSIBLE FOR NEW YORK'S WATER RESOURCES

THE WATER RESOURCES COMMISSION – Coordinator and Policy Maker

Because of the diversity of agencies involved with water resources activities, and because of the federal emphasis on regional developments, the Water Resources Commission is particularly designed to be a coordinating agency with the interests of the people of New York State as its primary concern.

Serving as chairman is the State's Conservation Commissioner. Members are the Superintendent of Public Works, the Attorney General and the Commissioners of the Departments of Health, Commerce, Agriculture and Markets, and the Office for Local Government. The membership is completed by four lay advisors representing industry, political subdivisions, agriculture and the sportsmen of the State. (See Chart 1 below).

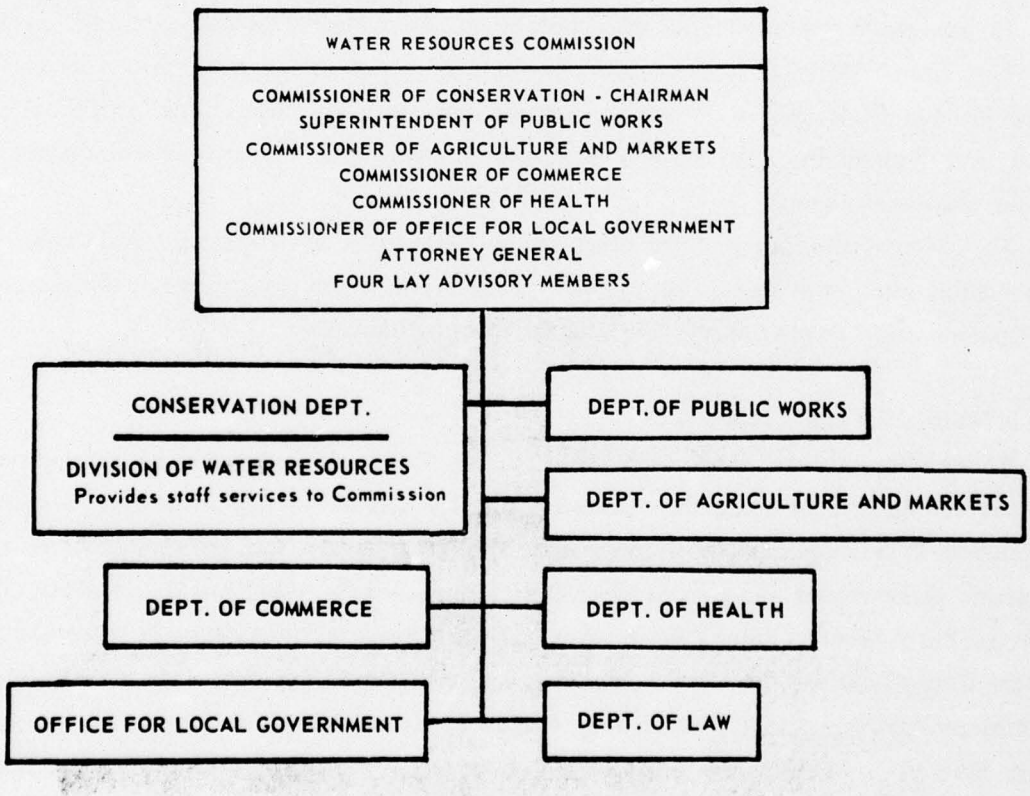


Chart 1

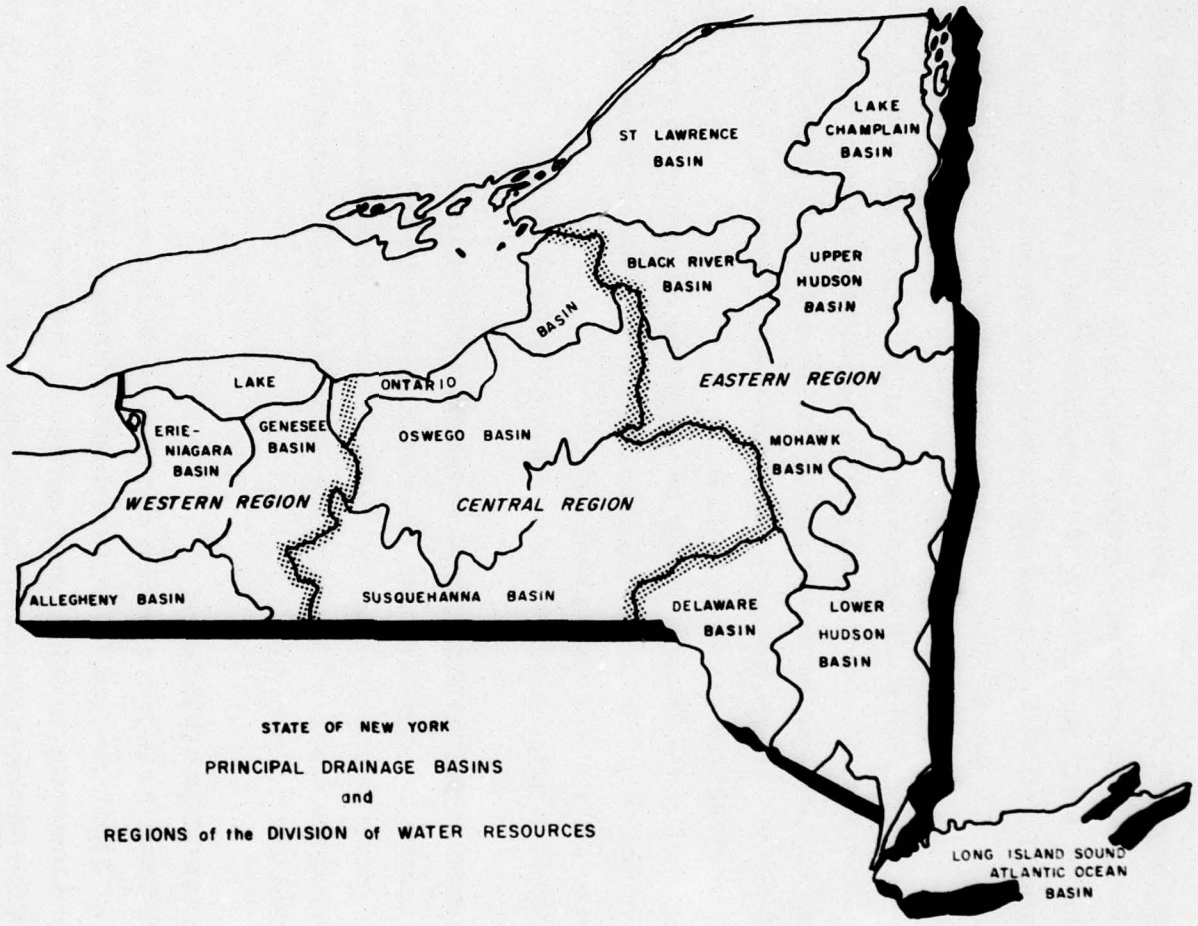
The Water Resources Commission is charged with coordinating the functions of every State agency concerned with water resources and formulating State policy regarding the conservation, development and use of the State's water resources. The Commission's duties include the following: the planning and development of our water resources; undertaking studies on a regional basis for the protection, conservation, development and use of water resources of any region of the State, preferably with local participation; the apportionment of water supply for public water systems; the inspection of the purity of the water supply and of the works constructed; the control of well drilling on Long Island; the licensing of certain water used in the generation of power; the classification of streams for pollution control; the drainage of agricultural lands, primarily through districts set up for this purpose; river regulation and river improvement, through districts set up for these purposes; flood control; the planning of water supply for intermunicipal areas; the protection of stream beds from disturbance, the control of dredging and fill in navigable waters, and the control of the construction of dams and docks.

The Water Resources Commission, through its member agencies, acts as the agent for the State of New York in partnership ventures with federal and local entities and represents the State's interest in interstate water resources planning and development work.

The Commission may draw upon the various agencies represented thereon for specialized staff services. The primary staff arm of the Commission, however, is the Conservation Department's Division of Water Resources.

THE DIVISION OF WATER RESOURCES

Furnishing direct staff services to the Water Resources Commission and serving as its secretariat, this Division has the primary role in the field of water resources. It is responsible for interdepartmental coordination, communications and records. It provides management of the Commission's affairs and contracts. The Division furnishes technical staff work for the Conservation Commissioner and the Deputy Commissioner for Water Resources. These Commissioners and the Assistant Commissioner for Water Resources, who is Director of the Division, serve as New York State representatives on several interstate agencies and planning groups. Multi-purpose development of our water resources demands comprehensive planning, and this is a principal contribution of the Division.



STATE OF NEW YORK

PRINCIPAL DRAINAGE BASINS

and

REGIONS of the DIVISION of WATER RESOURCES

Map B (See Page 12)

The appraisal of specific project proposals, plans and technical reports that affect water resources is also a responsibility of the Division. Its recommendations serve as the basis for action by the Commission and it serves as a clearing house for information for State agencies and the public on our water resources.

To permit a decentralized approach to planning activities, the State is divided into three areas (See Map B, p. 11), each having a regional office. Each region is served by district offices at appropriate locations. These local offices provide staff services and perform and coordinate planning activities for Regional Water Resources Planning and Development Boards (See p. 29). In addition, the State responsibilities related to the various interstate and State-federal river basin surveys are met through their regional and district offices.

The staff of the Division makes investigations and conducts public hearings on behalf of the Water Resources Commission and presents recommendations to the Commission on matters coming before it.

Other State agencies concerned with water resources include:

THE TEMPORARY STATE COMMISSION ON WATER RESOURCES PLANNING

Primarily a legislative body, this Commission drafts and recommends legislation to conserve and develop the water resources of the State. It is composed of three members appointed by the Senate, four by the Assembly and two by the Governor (See Chart 2, page 13).

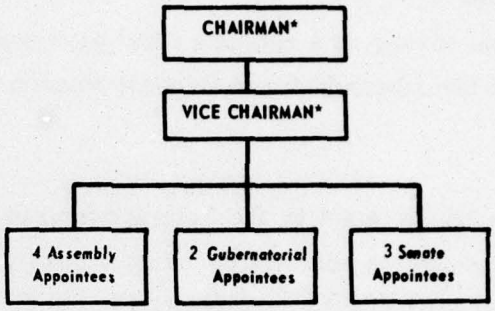
THE CONSERVATION DEPARTMENT

The Department, in conjunction with the other departments which are members of the Water Resources Commission, is responsible for the conservation of water and related land resources, as well as having many other functions. (See Chart 3, page 13). In addition to the primary functions of the Division of Water Resources already described, other Divisions of this Department are concerned with water resources as follows:

The Division of Lands and Forests

Administration of over 3 million acres of land area, including the lakes, ponds, streams, rivers and coastline lying therein, is the primary function of this Division. The State Forest Preserve represents more than 2.6 million acres of the lands under the supervision of the Division. It is responsible for all recreational facilities in the areas under its jurisdiction, including 765 miles of foot trails, 258 lean-to

TEMPORARY STATE COMMISSION ON WATER RESOURCES PLANNING



*Appointed by Members

Chart 2 (see page 12)

CONSERVATION DEPARTMENT

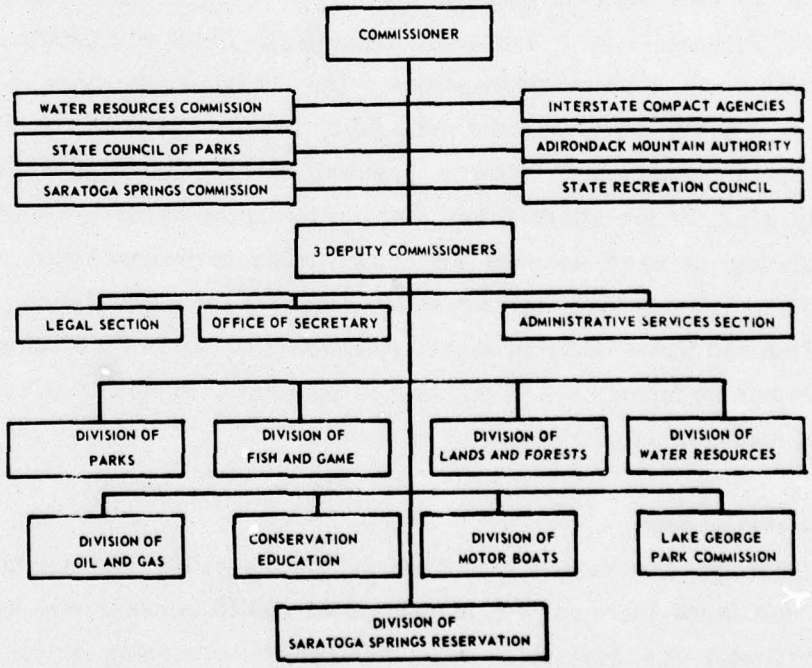


Chart 3 (see page 12)

shelters and 6,000 tent and trailer sites at 41 locations. The Division cooperates with the U. S. Forest Service in the Small Watershed Program and other federal-State river basin studies.

The Division also serves as a regional State park commission for the 16 Forest Preserve counties in the Adirondack and Catskill Mountain regions.

The Division of Parks

This division acts as staff to the State Council of Parks which is the central policy determining agency on matters concerning park planning, administration and outdoor recreation. There are 10 park regions in the State. Nine of these are under the jurisdiction of the Division. The Forest Preserve which forms the tenth region is under the direction of the Division of Lands and Forests.

The Division of Fish and Game

The administration and management of the State's fish and wildlife resources is carried out by this division through four bureaus: Fish, Game, Law Enforcement and Marine Fisheries. It has special units in the fields of pollution, engineering, land acquisition and technical publications. The Division's purpose is to perpetuate and enhance wildlife resources for the public. Thus, it operates fish hatcheries and game farms to supplement wildlife populations and determines what areas are sufficiently sanitary for shellfishing. Part of its duties is the development of regulations relating to open seasons and other rules governing hunting, trapping and fishing, and it provides the necessary enforcement of these regulations.

The Fish and Game Division shares financially in the Small Watershed Program and it receives in federal aid 75 per cent of the cost of various fish and wildlife research and management projects.

The Division of Motor Boats

This division establishes standards of boating safety and sanitation. It is responsible for these matters: the inspection of public vessels; education in the use of motor boats; the review of local ordinances governing navigation on State waterways and a program of aid to counties enforcing the navigation law. The Division also chooses sites for boat ramps on public lands.

THE DEPARTMENT OF HEALTH

The primary concern of this department is the safeguarding of the public health. The Department's responsibilities in the field of water resources — water quality surveillance, sanitary control of water supplies and pollution abatement and control — are administered by the Division of Environmental Health Services through the Department's regional and district offices. (See Chart 4 below).

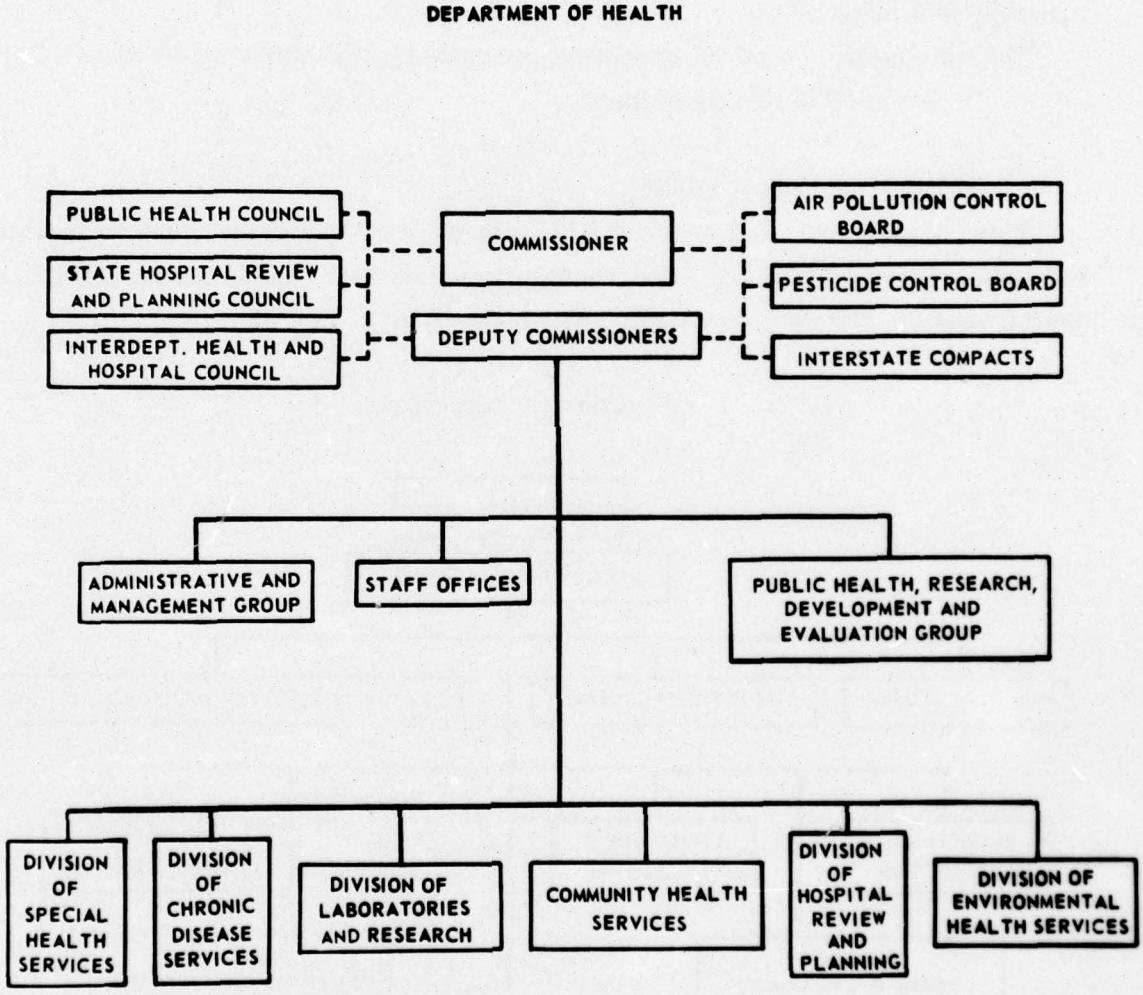


Chart 4

These activities include: enforcement of the water pollution control laws; technical aspects relating to the establishment of standards of water purity for appropriate usage and classification of streams accordingly; review and approval of plans for public water supply and sewage disposal systems; studies of municipal and intermunicipal water supply and sewerage facilities; administration of programs of State grants to municipalities for the construction of water supply and waste treatment facilities and for their proper operation; and research in water and sewage treatment methods.

The administration of the programs authorized by an ACT FOR PURE WATERS (See p. 35) is vested in this department.

THE DEPARTMENT OF PUBLIC WORKS

This department is concerned with a number of important functions in water resources. Among them are flood control, beach erosion, hurricane protection and operation of the State's Barge Canal system (See Chart 5 below).

DEPARTMENT OF PUBLIC WORKS

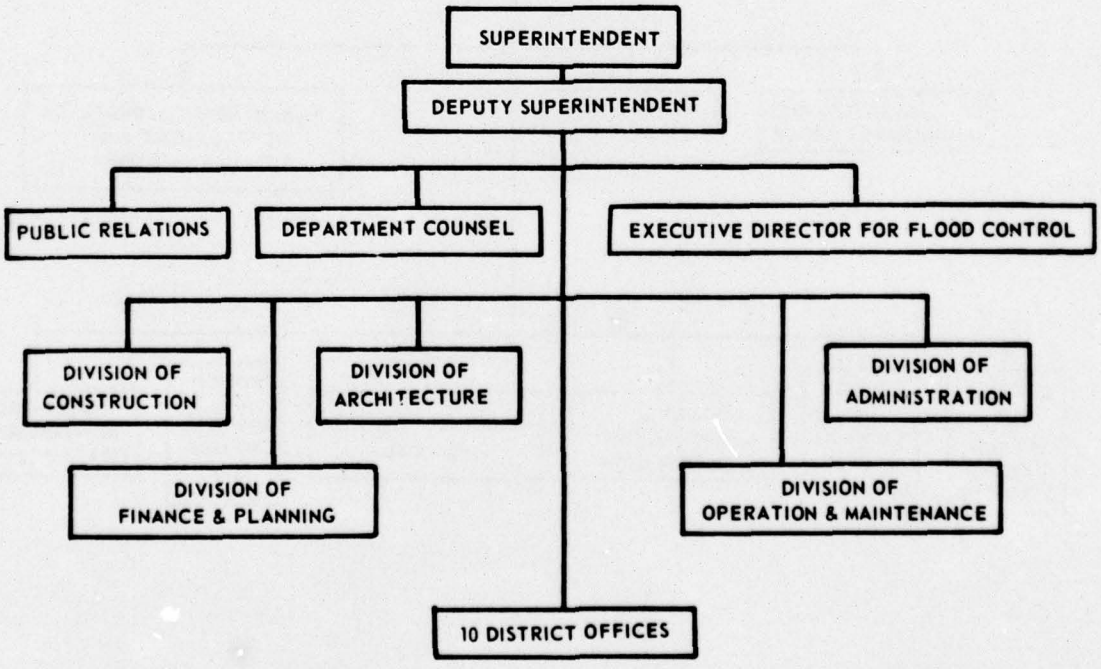


Chart 5

Sixty-eight flood control facilities, one dam and all beach erosion and hurricane protection works are under jurisdiction of the Office of the Executive Director of Flood Control. The State participates with the federal government in a long-range program of flood control by providing all non-federal requirements such as lands and rights-of-way, utility relocation or reconstruction, and maintenance where required by Congressional authority. The Department participates with the federal government in beach erosion and hurricane projects, acting as the local interest and as required by Congressional authority. It also has a State program of beach erosion which is carried out with the cooperation of municipalities. Operation and maintenance of the State's 500 miles of canals and waterways is a responsibility of the Division of Operation and Maintenance. Included are the operation of 57 locks, dredging, repair of banks, aids for navigation and regulation of use of canals by commercial and pleasure craft. The waterways link New York City with Lake Champlain and the Great Lakes.

THE DEPARTMENT OF AGRICULTURE AND MARKETS

The Department of Agriculture and Markets (See Chart 6 below) has the responsibility of overseeing the production, processing and distribution of the State's

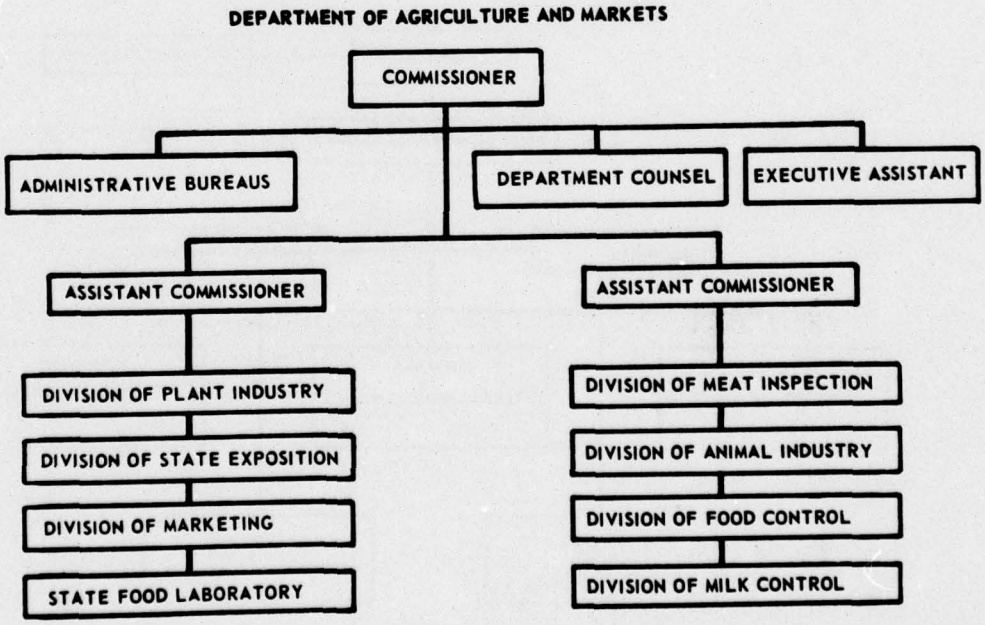


Chart 6

agricultural products. Consequently, meeting present and future water needs of farmers is of primary interest to the Department.

It estimates these needs, evaluates the benefits that will accrue if water is furnished for non-domestic use, such as irrigation, and estimates the repayment capacity of agricultural lands for supplemental water supplies.

THE DEPARTMENT OF LAW

Because the Attorney General advises the Water Resources Commission and its subcommittees on all legal matters, the Attorney General is one of the seven primary members of the Commission.

The Department of Law's Bureau of Water Resources handles all legal actions, proceedings and appeals involving determinations of the Water Resources Commission.

THE DEPARTMENT OF COMMERCE

Industrial and recreational development within the State are important responsibilities of the Department of Commerce. (See Chart 7 below).

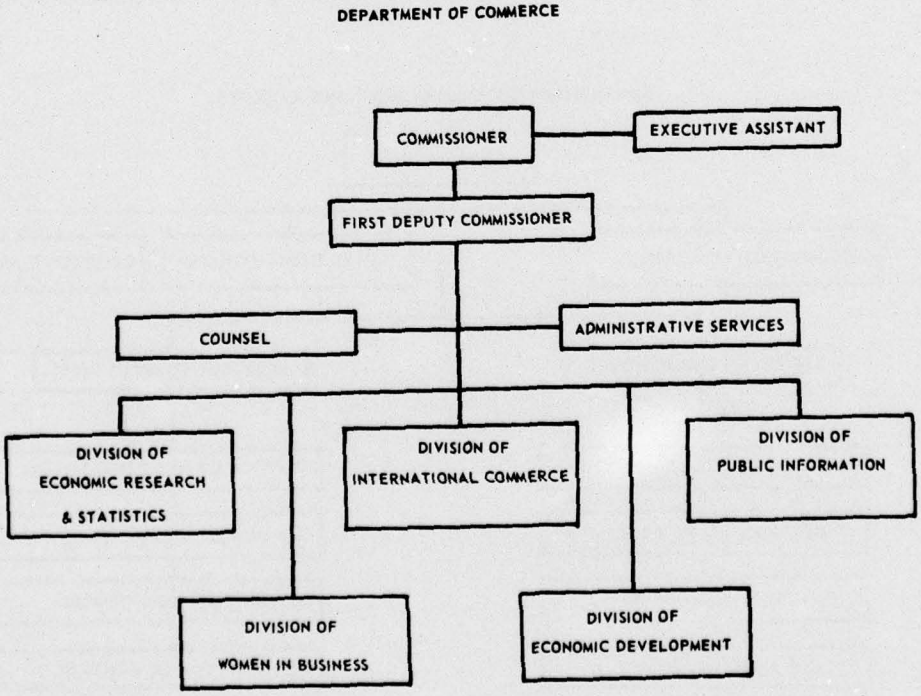


Chart 7

The attraction of tourists to the State of New York explains its interest in fresh and salt water recreational areas. Business firms now located in New York insist upon adequate supplies of fresh water for their operations, and new industries are attracted to the State because it is blessed with sufficient quantities of such water.

THE OFFICE FOR LOCAL GOVERNMENT

This agency in the Executive Department aids local governments to develop more effective services by securing aid and assistance from other State agencies and the federal government. It acts as a clearing house for information and makes studies that help to solve problems common to many local governments. (See Chart 8 below). Important among these are the improvement of water supply facilities and the fight against polluted waters.

THE OFFICE OF PLANNING COORDINATION

This office is the State's central long-range planning agency. In this capacity, it sponsors both regional and statewide planning programs, coordinates the functional planning of the line agencies with the general plan and coordinates State planning

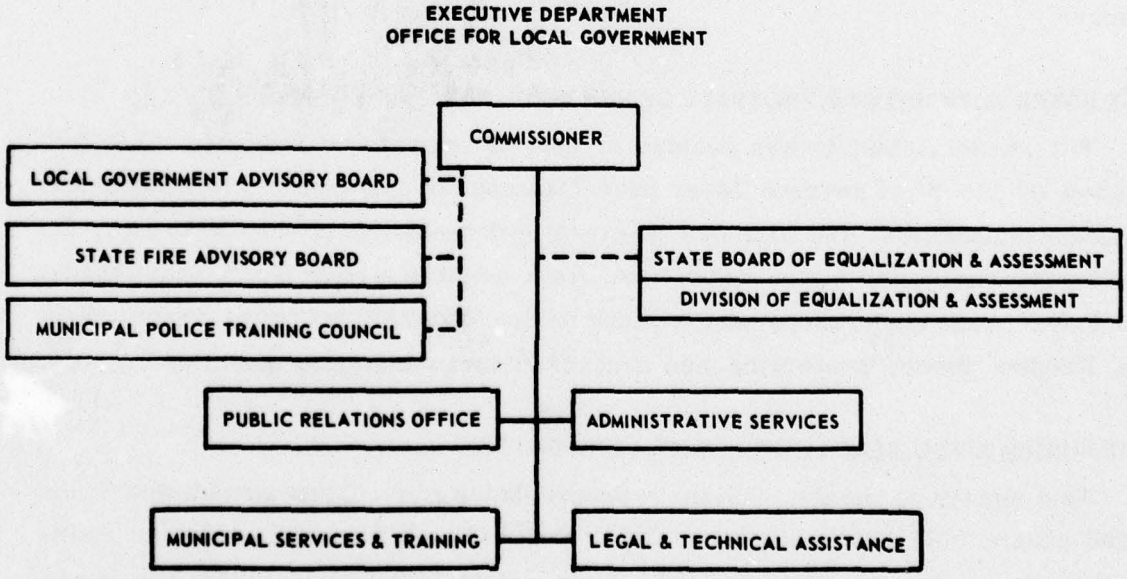


Chart 8

with local and federal planning activities. The Division of Water Resources of the Conservation Department performs the water-oriented aspects of this planning for the Office of Planning Coordination.

THE OFFICE OF ATOMIC AND SPACE DEVELOPMENT

This agency in the Executive Department was originally created to encourage the development of public and private atomic research. Its scope has been broadened to include the licensing and inspection of plants employing radioactive materials. The agency is currently planning for water desalination facilities on Long Island.

THE DEPARTMENT OF PUBLIC SERVICE

The regulation of public utilities in New York State, including privately-owned water companies valued at $30,000 or more, is the responsibility of the Public Service Commission and its administrative organization, the Department of Public Service.

The Commission approves stock issues and transfers of property for privately-owned water utilities, reviewing records and approving rates and charges for these companies. Staff members inspect and test water plant and equipment, advise on operational and rate matters, investigate complaints and prepare reports on tariff filings.

THE POWER AUTHORITY OF THE STATE OF NEW YORK

The Power Authority was created in 1931 to improve the International Rapids section of the St. Lawrence River near Massena, in cooperation with federal and Canadian authorities. The aim was to create hydro-electric power and to clear the rapids for navigation at the same time. As a result of a later treaty with Canada, the Power Authority's scope was widened to develop additional power resources on the Niagara River, preserving and enhancing, meanwhile, the beauty of the falls.

THE HUDSON RIVER-BLACK RIVER REGULATING DISTRICT

This agency is charged with the responsibilities of regulating streamflow in the 6,500 square mile Black River and Upper Hudson River Basins. The district maintains and operates the Stillwater, Old Forge, Sixth Lake and Sacandaga reservoirs to regulate streamflow for the health, safety and welfare of the public. These reservoirs also provide recreational facilities and water for the generation of power.

The cost of constructing and maintaining these river regulating projects is apportioned among the public corporations, municipalities and parcels of real estate that are benefited.

PORT MANAGEMENT AGENCIES

Port of New York Authority

Created in 1921 by the States of New York and New Jersey with the concurrence of the President and the Congress, the Port of New York Authority has the duty of making recommendations to Congress and to the states concerned for the better conduct of commerce passing through the Port of New York. It also appears before regulatory bodies in protection of the Port's interests. The Authority is a public corporation, empowered to purchase, construct, lease and operate any terminal or transportation facility within the port district.

Albany Port District Commission

The Albany Port District embraces the city of Albany, the city of Rensselaer, and adjacent lands and water in the Hudson River.

Niagara Frontier Port Authority

The Niagara Frontier Port Authority is a public benefit corporation created to operate a port district which embraces the cities of Buffalo, Lackawanna and Tonawanda and the towns of Hamburg, Amherst, Cheektowaga and West Seneca.

Ogdensburg Bridge and Port Authority

This authority was created to construct and operate an international toll bridge between Ogdensburg, New York and Prescott, Ontario, which was officially opened in September, 1960. In 1963, the Authority was given the further responsibility of developing the Port of Ogdensburg on the St. Lawrence River.

Port of Oswego Authority

The function of this agency is to survey, develop, operate and promote port facilities in the Oswego Port District which embraces the city of Oswego and the town of Scriba.

THE DELAWARE RIVER BASIN COMMISSION

Created in 1961 by a compact among the States of New York, Pennsylvania, New Jersey and Delaware and the federal government, this agency is responsible for the planning, conservation, use, development, management and control of the water and related natural resources of the Delaware River Basin. (See Chart 9 below).

The 12,750 square mile Delaware Basin supplies water to more than 13 million inhabitants of the New York City and Philadelphia metropolitan areas.

The Commission is the only agency of its type in which the participating states are full operating partners with the federal government. Its five members are the governors of the four signatory states and the Secretary of the Interior.

Encompassed in the Commission's plan for the basin are flood control, water supply, hydro-electric power, recreation, water quality management, fish and wildlife preservation, soil conservation and other functions.

The Commission's administrative, planning and construction costs are financed by the signatory parties.

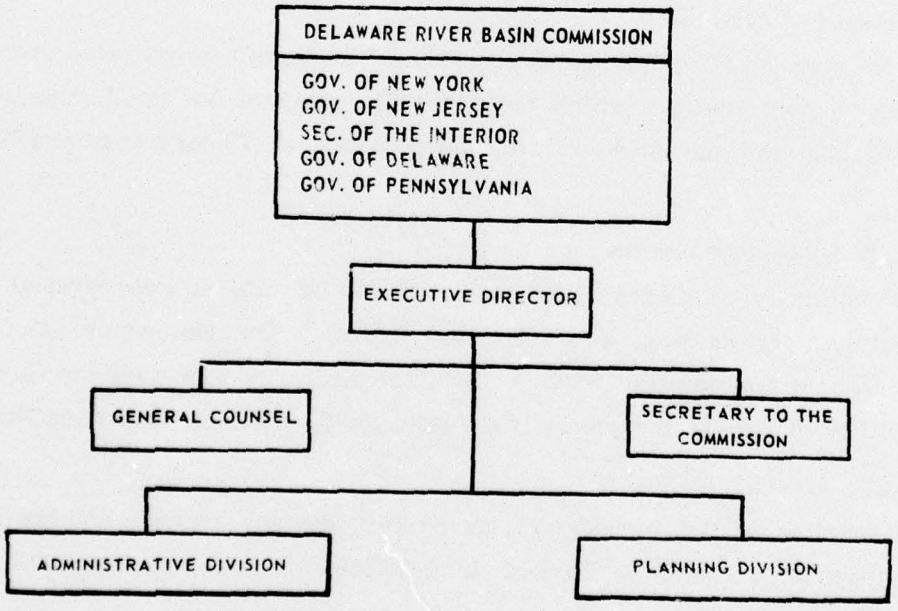


Chart 9

THE OHIO RIVER VALLEY WATER SANITATION COMMISSION

Control of water pollution in the Ohio River drainage basin is the concern of this interstate agency. It is made up of representatives from Ohio, West Virginia, Pennsylvania, Illinois, Indiana, Kentucky, Virginia and New York as well as from the federal government. (See Chart 10 below).

The Commission prescribes treatment requirements for the waters of the basin and has legal powers to enforce standards and requirements.

There are three commissioners from New York State. One is the Commissioner of Health, and the other two are appointed by the Governor. Annual appropriations are made to cover New York State's share of the Commission's operating cost.

THE NEW ENGLAND INTERSTATE WATER POLLUTION CONTROL COMMISSION

Control of pollution in the interstate waters of the New England area is the work of this agency, which consists of representatives of all of the New England states and New York. The Commission is responsible for establishment of standards

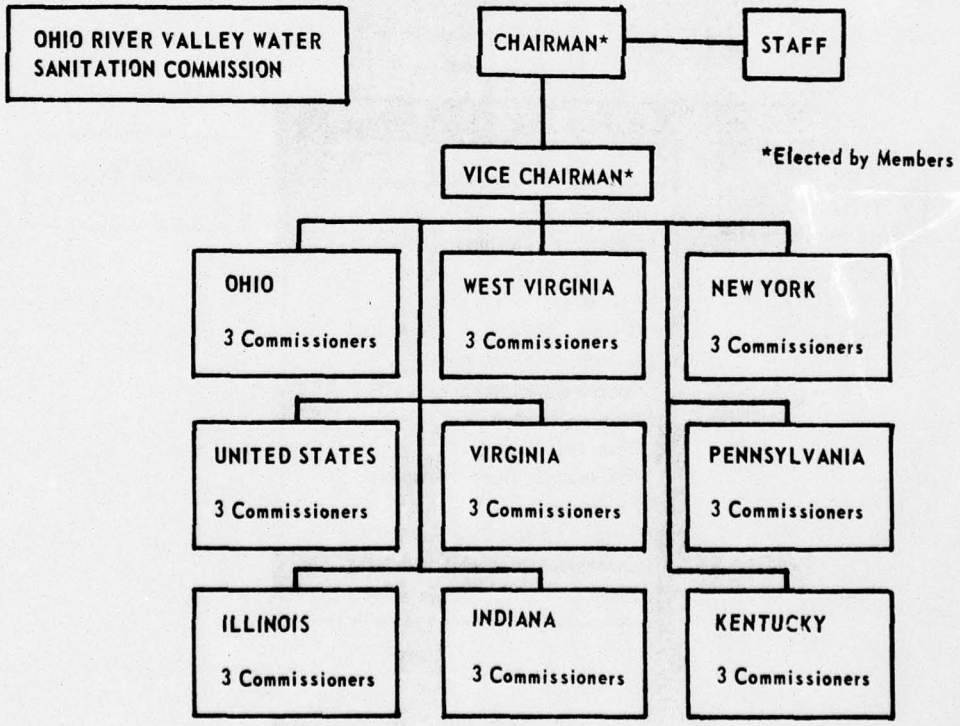


Chart 10

of water quality for various classifications of use. The signatory states appropriate funds recommended by the Commission for operating expenses.

THE NEW YORK – VERMONT INTERSTATE COMMISSION ON THE LAKE CHAMPLAIN BASIN

This agency is responsible for fostering development of the resources of the Lake Champlain Basin. (See Chart 11 below). In carrying out this responsibility, the Commission promotes cooperation between New York, Vermont and the Canadian Province of Quebec. New York is represented by eight members, including the Commissioners of Health, Commerce, and Agriculture and Markets. The signatory states bear the operating costs.

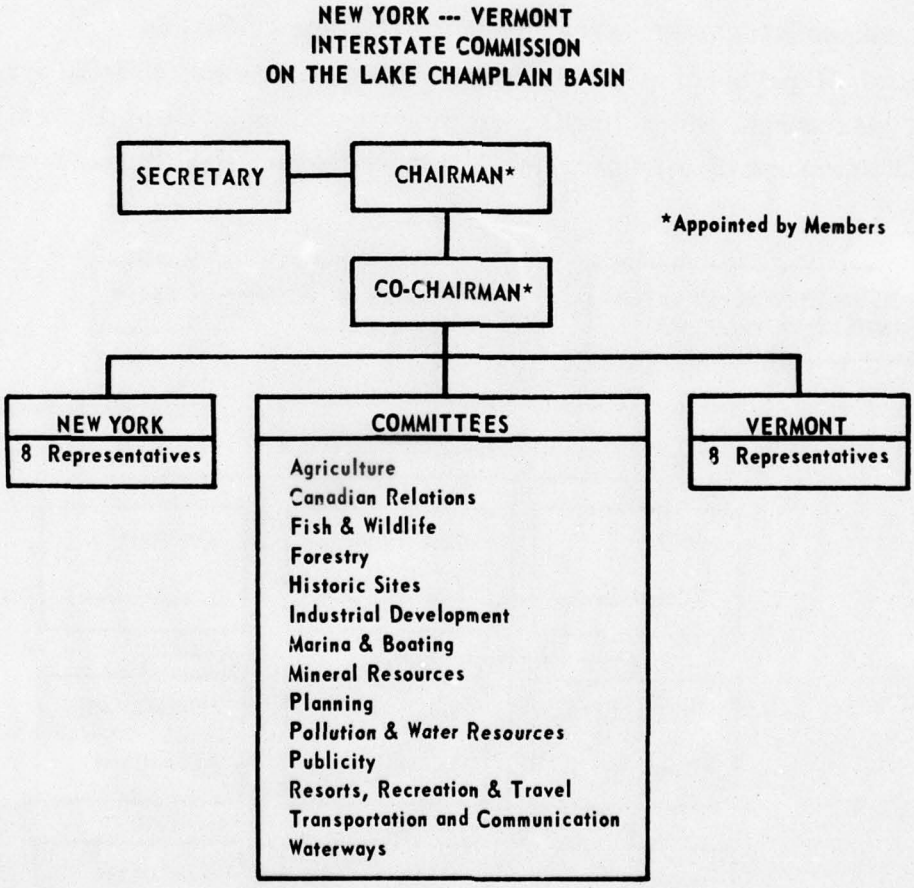


Chart 11

THE GREAT LAKES COMMISSION

The states of Illinois, Indiana, Michigan, Minnesota, New York, Ohio, Pennsylvania and Wisconsin make up the membership of this Commission. (See Chart 12 below). The compact which formed the Commission permits inclusion of the Canadian Provinces of Quebec and Ontario, although these regions have not as yet joined.

The goal of the Commission is to promote the orderly, integrated and comprehensive development, use and conservation of the water resources of the Great Lakes Basin. In its work it considers all aspects of the resources of the basin, including industrial, commercial, agricultural, residential and recreational use. However, the Commission's powers are limited to study and recommendation.

The New York State delegation consists of five commissioners. The operating expenses are financed by the signatory states.

THE INTERSTATE SANITATION COMMISSION

This agency is responsible for antipollution measures affecting coastal, estuarial and tidal waters in a district that extends from Sandy Hook in New Jersey,

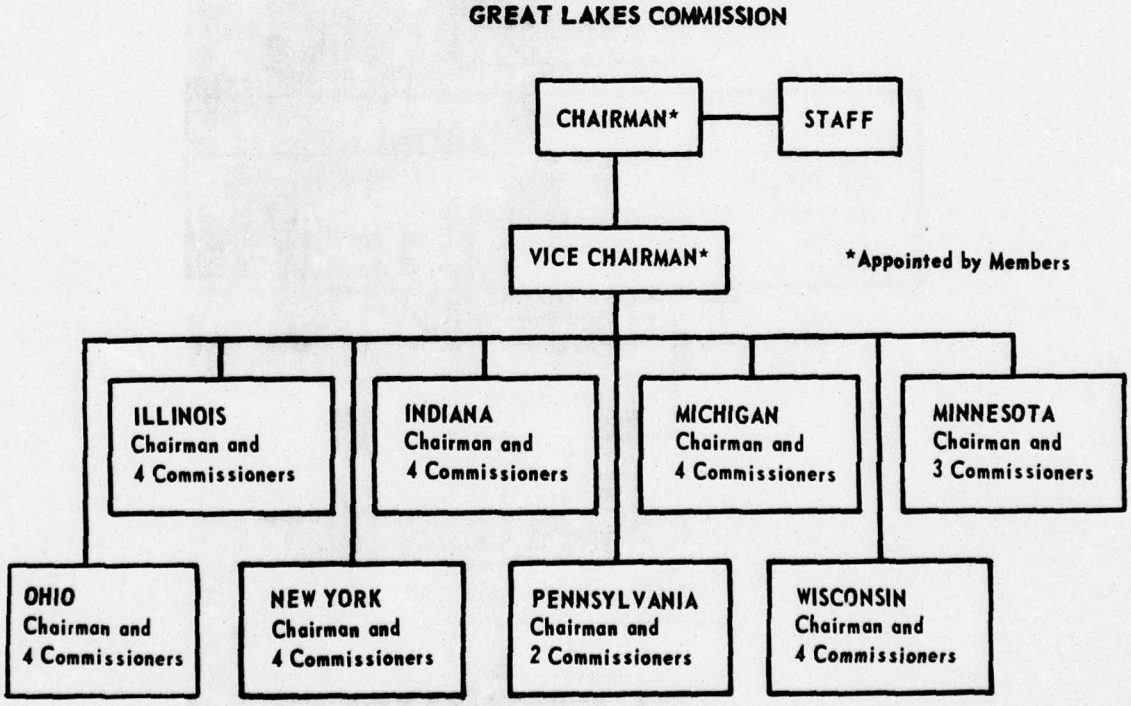


Chart 12

includes all of New York Harbor, north on the Hudson River to the northerly boundaries of Westchester and Rockland Counties, then easterly to Long Island Sound, then to New Haven on the Connecticut shore and Port Jefferson on the north shore of Long Island. Along the south shore of Long Island, it extends easterly to Fire Island Inlet. (See Chart 13 below). It has investigative power and may resort to the courts to compel enforcement of Commission orders. The Commission seeks to develop better coordination and more active cooperation among the interested entities toward the construction of necessary waste treatment works to improve and protect water quality in the district.

In addition, it has been given responsibilities relating to air pollution problems affecting New York and New Jersey.

INTERSTATE SANITATION COMMISSION

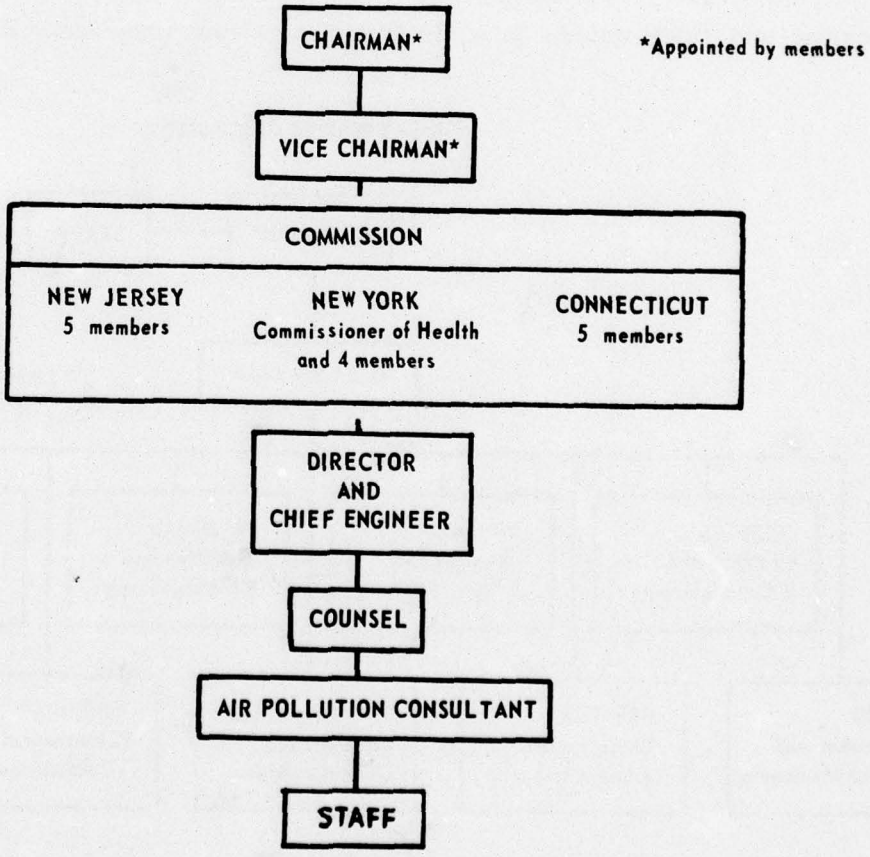


Chart 13

The signatory states of New York, New Jersey and Connecticut appropriate funds recommended by the Commission for its work.

THE INTERSTATE ADVISORY COMMITTEE ON THE SUSQUEHANNA RIVER BASIN

The members of this agency are New York, Pennsylvania and Maryland. (See Chart 14 below). Its principal functions are to promote and coordinate studies for the development and management of the waters and related resources of the Susquehanna Basin, and to draft an Interstate Compact to create a permanent intergovernmental agency for the proper management and effective utilization of the water and associated land resources of the basin.

This committee is supported financially by the States of New York, Pennsylvania and Maryland.

INTERSTATE ADVISORY COMMITTEE ON THE SUSQUEHANNA RIVER BASIN

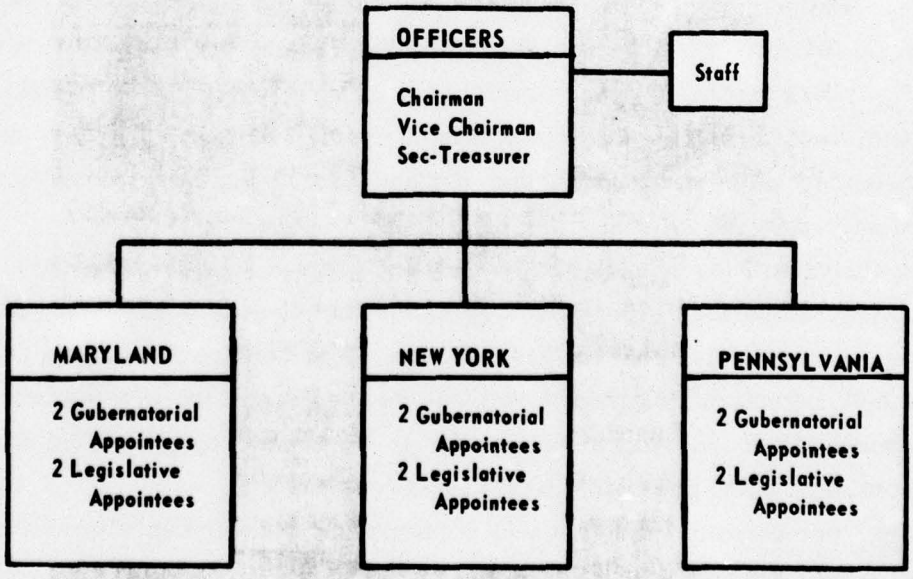


Chart 14

CURRENT PLANNING PROGRAMS

TYPES OF STUDIES

Under its far-reaching Water Resources Planning Legislation of 1959, New York State has set up the administrative machinery capable of meeting the demands of tomorrow. The Water Resources Commission achieves effective coordination at all levels of government and provides the support needed for planning to meet future water resources goals. Some planning programs are carried out by State agencies alone; some are joint efforts of the State and local governments; some are State-federal or interstate partnership programs.

Planning programs may be considered to be divided into two types: Type I, or Comprehensive Planning Studies and Type II, or Framework Studies.

Type I Studies

A Type I Study is intended to provide a comprehensive plan for the optimum development of the water resources of a region. It usually includes the following steps:

1. An inventory of the water resources of the region, including quantity and quality of surface and ground waters and the initiation of an economic base study.
2. The determination of needs to satisfy all of the diverse water resources requirements, not only for the immediate future but also for as much as fifty years ahead. The economic base study provides the projections and estimates of future population, employment, income, etc., that must be translated into water uses and demands for intervening decades during the fifty-year period.
3. An analysis of the capabilities for meeting present and future needs.
4. A study of various alternatives to satisfy the diverse needs, many of which may compete with one another. This involves considerations and analyses of both structural and non-structural measures and the development of the several alternative plans that appear to be economically feasible and show promise of being acceptable to the local people.
5. After comparative analysis and screening of the various alternatives, the optimum plan of comprehensive development may be evolved. This, of course, may well include alternative ways of meeting the same need, in order to allow final selection of the solution to be made in the future.

6. The completed plan will include recommendations for the necessary management framework to implement the plan effectively, including financing, construction and operation of the necessary projects.

The comprehensive plan evolved as a result of this type of study is of a scope calculated to assure prompt and orderly development of the water resources for all beneficial uses, and would show the available and feasible sites for the installation and operation of necessary projects.

Type II Studies

This type of study is a preliminary, or reconnaissance, investigation intended to provide broad scale analyses of water and related land use problems and to furnish general appraisals of the probable nature, extent, and timing of measures for their solutions.

The scope of the investigation will include the first three steps outlined above for Type I studies, although usually with less detail than required for a comprehensive study. The framework plan will be based on these initial planning steps, using general relations, reasoned approximations, available data and the judgment of experienced planners.

While potential reservoir sites may be identified, project formulation studies cannot be undertaken. The study will reach conclusions as to the urgency of water and related land problems in the major watersheds or subwatersheds located in the region, and recommend priorities for the more detailed studies leading to action programs.

A broad range of variability in the intensity of Type II studies is possible. By means of supplementary studies it is possible to upgrade a framework study to a more comprehensive one, especially with regard to identifying the economically feasible projects justified within the next decade or two.

REGIONAL BOARD STUDIES

At the present time, most comprehensive, or Type I, planning in New York State is conducted under the auspices of Regional Water Resources Planning and Development Boards established under the provisions of Article V, Part V, of the Conservation Law.

Regional Water Resources Planning and Development Boards are established after public hearings and approval by the Water Resources Commission. This type

of board is most appropriate for the study of an intra-state river basin embracing all, or parts, of one or more counties. However, it can also be used effectively for interstate river basin studies.

A Regional Board has seven members selected by the Water Resources Commission from a list of 14 names submitted by the counties involved. Each member represents one of five specified interests or is a member-at-large. The specified interests are agriculture, industry, public water supply, municipal corporations and outdoor recreation, including fish and wildlife interests. They are responsible for the conduct of the study and for evolving a comprehensive plan of development of the region's water resources.

Upon approval of a study, the Commission, through the Division of Water Resources, provides office space, equipment, clerical, engineering, legal and other personnel and services to the board. Of the study's total cost, 75 per cent is borne by the State and the other 25 per cent by the participating counties.

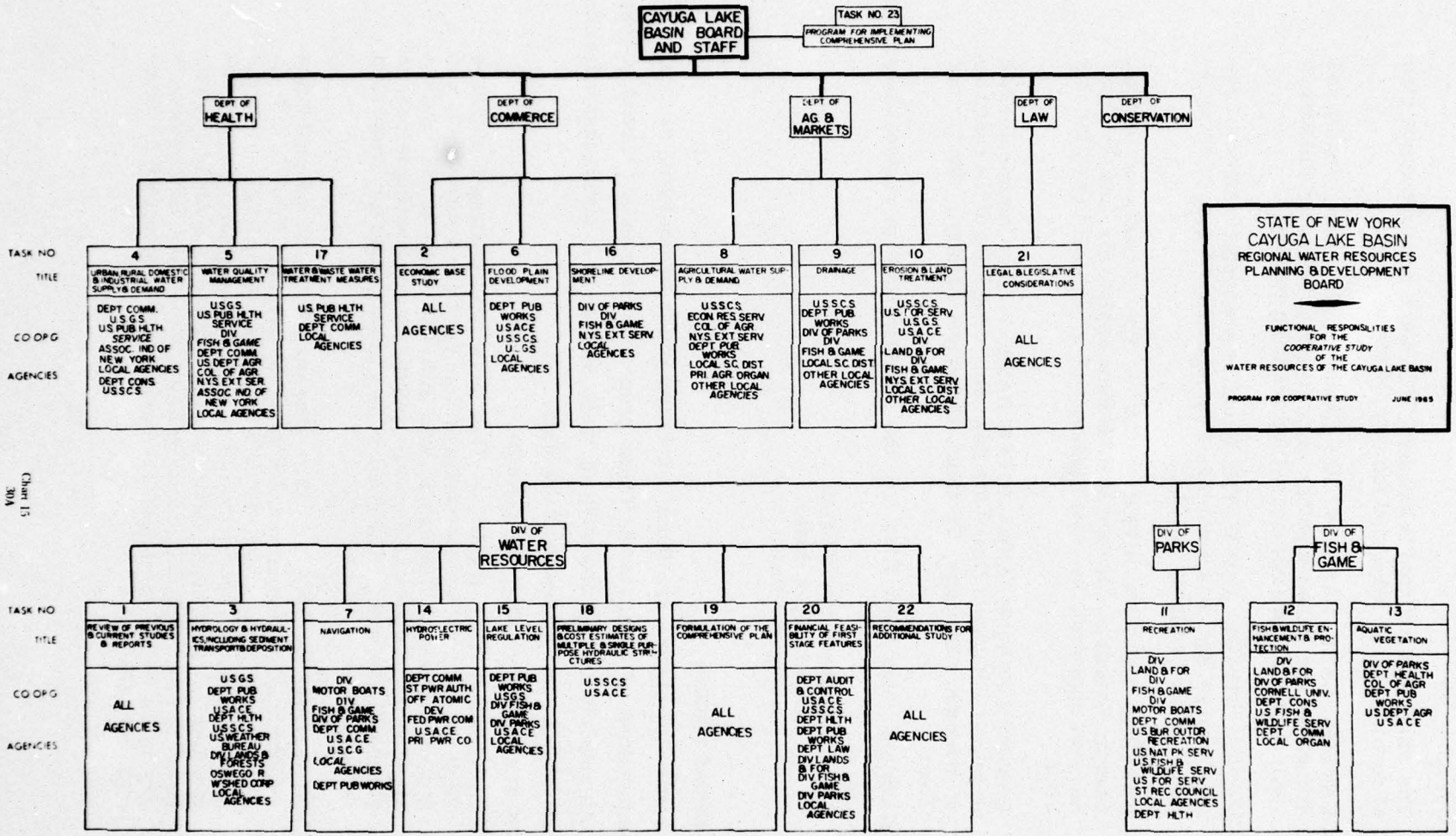
Under the auspices of the Regional Board, the staff of the Division of Water Resources performs a comprehensive, Type I, study of the water resources development of the region. A typical organization of a Regional Board study is illustrated in Chart 15 on the following page.

Intermunicipal public water supply studies under Part V-A, Article V of the Conservation Law can be made concurrently with multi-purpose water resources planning studies. The State Department of Health is the agency of the Water Resources Commission which administers this single-purpose program. Effective coordination by the regional board serves to minimize possible duplication of effort. Under Part V-A, an engineering and economic feasibility study results in a plan for the development of projects to provide adequately for present and reasonably foreseeable area-wide public water supply needs. When approved by the Water Resources Commission, the State provides 100 per cent aid for this type of study, which is an important part of broad water resources planning.

Finally, a comprehensive plan is developed, identifying projects economically justified for development in the foreseeable future, and outlining possible means of financing their construction.

A summary of Regional Board and River Basin Studies that are now in progress under Article V, Part V of the Conservation Law follows:

ERIE-NIAGARA BASIN — A 2,000 square mile area consisting of portions of Cattaraugus, Erie, Genesee and Wyoming Counties.


CAYUGA LAKE BASIN BOARD AND STAFF
TASK NO. 23
PROGRAM FOR IMPLEMENTING COMPREHENSIVE PLAN
DEPT OF HEALTH
DEPT OF COMMERCE
DEPT OF AG & MARKETS
DEPT OF LAW
DEPT OF CONSERVATION
TASK NO
TITLE
CO OPG AGENCIES
4
URBAN, RURAL DOMESTIC & INDUSTRIAL WATER SUPPLY & DEMAND
DEPT COMM. U.S.G.S. U.S. PUB. HLTH. SERVICE ASSOC. IND. OF NEW YORK LOCAL AGENCIES DEPT. CONS. U.S.C.S.
5
WATER QUALITY MANAGEMENT
U.S.G.S. U.S. PUB. HLTH. SERVICE DIV. FISH & GAME DEPT. COMM. U.S. DEPT. AGR. COL. OF AGR. N.Y.S. EXT. SER. ASSOC. IND. OF NEW YORK LOCAL AGENCIES
17
WATER & WASTE WATER TREATMENT MEASURES
U.S. PUB. HLTH. SERVICE DEPT. COMM. LOCAL AGENCIES
2
ECONOMIC BASE STUDY
ALL AGENCIES
6
FLOOD PLAIN DEVELOPMENT
DEPT. PUB. WORKS U.S.A.C.E. U.S.C.S. U.G.S. LOCAL AGENCIES
16
SHORELINE DEVELOPMENT
DIV. OF PARKS DIV. FISH & GAME N.Y.S. EXT. SERV. LOCAL AGENCIES
8
AGRICULTURAL WATER SUPPLY & DEMAND
U.S.C.S. ECON. RES. SERV. COL. OF AGR. N.Y.S. EXT. SERV. DEPT. PUB. WORKS LOCAL S.C. DIST. PRI. AGR. ORGAN. OTHER LOCAL AGENCIES
9
DRAINAGE
U.S.C.S. DEPT. PUB. WORKS DIV. OF PARKS DIV. FISH & GAME LOCAL S.C. DIST. OTHER LOCAL AGENCIES
10
EROSION & LAND TREATMENT
U.S.C.S. U.S. FOR. SERV. U.S.G.S. U.S.A.C.E. DIV. LAND & FOR. DIV. FISH & GAME N.Y.S. EXT. SERV. LOCAL S.C. DIST. OTHER LOCAL AGENCIES
21
LEGAL & LEGISLATIVE CONSIDERATIONS
ALL AGENCIES
STATE OF NEW YORK
CAYUGA LAKE BASIN
REGIONAL WATER RESOURCES PLANNING & DEVELOPMENT BOARD
FUNCTIONAL RESPONSIBILITIES FOR THE COOPERATIVE STUDY OF THE WATER RESOURCES OF THE CAYUGA LAKE BASIN
PROGRAM FOR COOPERATIVE STUDY
JUNE 1965
Chart 15 304
DIV OF WATER RESOURCES
DIV OF PARKS
DIV OF FISH & GAME
TASK NO
TITLE
CO OPG AGENCIES
1
REVIEW OF PREVIOUS & CURRENT STUDIES & REPORTS
ALL AGENCIES
3
HYDROLOGY & HYDRAULICS, INCLUDING SEDIMENT TRANSPORT & DEPOSITION
U.S.G.S. DEPT. PUB. WORKS U.S.A.C.E. DEPT. HLTH. U.S.C.S. U.S. WEATHER BUREAU DIV. LANDS & FORESTS OSWEGO R. W'SHED CORP. LOCAL AGENCIES
7
NAVIGATION
DIV. MOTOR BOATS DIV. FISH & GAME DIV. OF PARKS DEPT. COMM. U.S.A.C.E. U.S.C.G. LOCAL AGENCIES DEPT. PUB. WORKS
14
HYDROELECTRIC POWER
DEPT. COMM. ST. PWR. AUTH. OFF. ATOMIC DEV. FED. PWR. COM. U.S.A.C.E. PRI. PWR. CO.
15
LAKE LEVEL REGULATION
DEPT. PUB. WORKS U.S.G.S. DIV. FISH & GAME DIV. PARKS U.S.A.C.E. LOCAL AGENCIES
18
PRELIMINARY DESIGNS & COST ESTIMATES OF MULTIPLE & SINGLE PURPOSE HYDRAULIC STRUCTURES
U.S.C.S. U.S.A.C.E.
19
FORMULATION OF THE COMPREHENSIVE PLAN
ALL AGENCIES
20
FINANCIAL FEASIBILITY OF FIRST STAGE FEATURES
DEPT. AUDIT & CONTROL U.S.A.C.E. U.S.C.S. DEPT. HLTH. DEPT. PUB. WORKS DEPT. LAW DIV. LANDS & FOR. DIV. FISH & GAME DIV. PARKS LOCAL AGENCIES
22
RECOMMENDATIONS FOR ADDITIONAL STUDY
ALL AGENCIES
11
RECREATION
DIV. LAND & FOR. DIV. FISH & GAME DIV. MOTOR BOATS DEPT. COMM. U.S. BUR. OUTDR. RECREATION U.S. NAT. PK. SERV. U.S. FISH & WILDLIFE SERV. U.S. FOR. SERV. ST. REC. COUNCIL LOCAL AGENCIES DEPT. HLTH.
12
FISH & WILDLIFE ENHANCEMENT & PROTECTION
DIV. LAND & FOR. DIV. OF PARKS CORNELL UNIV. DEPT. CONS. U.S. FISH & WILDLIFE SERV. DEPT. COMM. LOCAL ORGAN
13
AQUATIC VEGETATION
DIV. OF PARKS DEPT. HEALTH COL. OF AGR. DEPT. PUB. WORKS U.S. DEPT. AGR. U.S.A.C.E.

The study was initiated in January, 1963 and a comprehensive plan of development is scheduled for completion in 1968.

CAYUGA LAKE BASIN — The Counties of Cayuga, Seneca and Tompkins are joined together on a Regional Board established in 1964. A plan of development will be available in 1970.

YATES, ONTARIO AND WAYNE Counties are cooperating on a Regional Board that was established in mid-1965. A plan of development will be available in 1970.

EASTERN OSWEGO RIVER BASIN — The Counties of Cayuga, Oneida, Onondaga, Oswego and Madison applied for, and the Commission approved, the establishment of a Regional Board for this area.

EASTERN SUSQUEHANNA RIVER BASIN — The Commission has approved a Regional Board for this basin consisting of the Counties of Broome, Chenango, Cortland, Delaware, Madison, Otsego and Tioga.

Applications have been filed for the establishment of regional boards in the following areas:

Allegheny River Basin
Mohawk River Basin
Black River Basin

JOINT PLANNING STUDIES

A number of studies are being conducted jointly by interstate or joint federal-State commissions or committees. These programs are usually framework (Type II) studies. An important State objective of these studies is to insure that federally devised projects will meet all needs of the State.

Joint studies now in progress include:

GENESEE RIVER BASIN — This is a Coordinating Committee Study which involves the states of New York and Pennsylvania and federal agencies. This study was initiated early in 1963 and the staff of the Division of Water Resources is contributing to certain phases of the study. The final report is scheduled for completion in 1967.

SUSQUEHANNA RIVER BASIN — The study is being conducted under a Coordinating Committee, involving the states of New York, Pennsylvania and Maryland and federal agencies. An interstate compact to provide for management and implementation of the developing comprehensive plan is being drafted. The study was initiated in June, 1963 and, here again, the Division of Water Resources is an active participant. A final report is scheduled for completion in 1969.

DELAWARE RIVER BASIN — The planning, development and management of the water and associated land resources of this basin are under the Delaware River Basin Commission. The Division of Water Resources provides technical data and evaluations to the Delaware River Basin Commission staff and acts as liaison for the New York agency participation.

OHIO RIVER BASIN — This is a framework study by a Coordinating Committee including 11 states and the federal agencies. The area in New York includes parts of Chautauqua, Cattaraugus and Allegany Counties in the Allegheny Basin. This study was initiated in September, 1963 and New York State began to participate actively in the study in mid-1964. A final report is scheduled for completion in 1967.

GREAT LAKES BASIN — Several studies are under way in this basin. The Corps of Engineers is making a study of levels for the International Joint Commission and the Federal Water Pollution Control Agency is conducting a large-scale water pollution control study of each of the Great Lakes and tributary basins.

HUDSON-MOHAWK-CHAMPLAIN INTERCOASTAL METROPOLITAN AREA — The Federal Water Pollution Control Agency has been authorized to conduct a comprehensive water pollution control study which will take seven years and cost $12 million to complete. This study also embraces the tri-state area centered around New York City. The State Health Department represents the New York State interests and the Water Resources Commission in this venture.

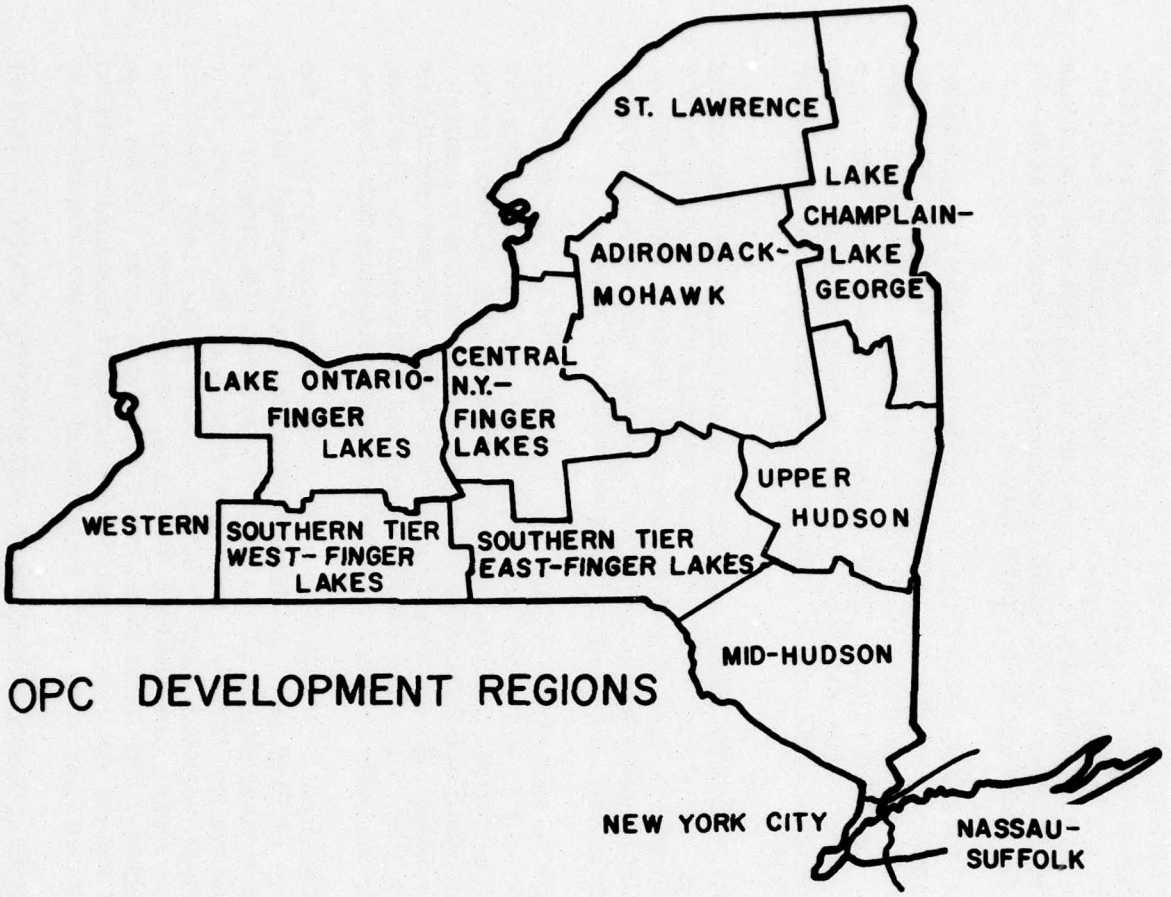
APPALACHIA PROGRAM — The water resources survey of the Corps of Engineers, the land stabilization, conservation and erosion control studies of the U. S. Department of Agriculture (Soil Conservation Service), and other aspects of the program cover thirteen Southern Tier Counties of New York. These interstate river basins are involved: Delaware, Susquehanna, Genesee and Allegheny. The Water Resources Commission works with the State and federal agencies to provide the extensive coordination needed to insure integration of the State's many water resources interests.

NORTH ATLANTIC REGIONAL FRAMEWORK STUDY — This $4 million study embracing 13 states, the District of Columbia, and five federal agencies with the North Atlantic Division, Corps of Engineers serving as chairman of the Coordinating Committee was initiated in January 1966. A plan of study has been evolved calling for completion of the study by 1970.

STATE FRAMEWORK STUDIES

Several programs have been established for conducting framework studies in various depths for various regions and for the State as a whole.

These programs include the following:



OPC DEVELOPMENT REGIONS

Map C

Studies for Office of Planning Coordination

In carrying out the central planning responsibilities outlined on page 19, the Office of Planning Coordination (OPC) is preparing long-range development plans for each of the Development Regions into which the State is divided. (See Map C, page 33). These studies are partially sponsored and funded by the Federal Department of Housing and Urban Development (HUD). The water-oriented aspects of these planning studies are being performed for OPC by the Division of Water Resources. Priority is initially being given to the Long Island and the Lake Champlain-Lake George Regions.

A two-year framework study of the State as a whole will also be undertaken by the Division for the OPC with expected financial assistance by HUD.

Accelerated Water Resources Program

The State, in 1965, initiated a six-year comprehensive program for the elimination of water pollution of its lakes, streams and rivers. This $1.7 billion Pure Waters Program (See p. 35) will accelerate water quality improvement. This massive stream clean-up, coupled with the severe effects of the extended drought in the northeast United States, has added a new degree of urgency to water resources planning. To meet these needs, Governor Rockefeller, on August 25, 1965, directed the Water Resources Commission to initiate an Accelerated Water Resources Program to gain the basic information necessary for planning and development in the minimum amount of time.

To begin this accelerated program, four eminent consulting engineering firms were retained to develop initial recommendations for alternative measures to meet short and long term needs on a statewide basis. These reconnaissance studies considered multi-purpose water needs, availability of water and potential reservoir sites. The results of these studies present generalized alternative development plans with preliminary estimates of development cost.

The Accelerated Water Resources Program does not preempt the importance of the regional planning board structure, but rather serves as a basis for immediate planning and development programs. It also provides a basic framework for future detailed river basin planning on a regional basis.

AN ACT FOR PURE WATERS

An important new step in the field of water resources in New York was taken in 1965 when the people of the State approved legislation providing funds for sewage treatment facilities to combat water pollution. This new law — known as the Pure Waters Bond Act — will insure State leadership in the federal-state-local partnership efforts to fight water pollution in New York.

The $1 billion bond issue will pay the State's six-year share, and prefinance the federal share, of sewage treatment plant construction and facilities costs to meet the stream classification standards that have been established by the Water Resources Commission in all parts of the State.

Funds are also provided for:

State aid to municipalities for operating and maintaining sewage treatment plants.

An automated system to monitor water quality in the State's principal rivers.

Expanded State research in water pollution control methods. Comprehensive sewerage needs planning.

Industrial incentives in the form of tax exemptions for the added value of pollution control equipment and a tax reduction for expenditures in constructing or improving waste treatment facilities.

The Pure Waters Program also makes possible:

More vigorous enforcement of the State's laws against water pollution.

State and federal action to eliminate water pollution by government institutions in New York State.

As a result of the six-year massive cleanup, water of adequate quality will be available for the many short- and long-range needs, which are being determined through the regional and river-basin studies.

THE STREAM PROTECTION LAW

Taking effect January 1, 1966, a new act transferred to the Water Resources Commission certain powers and duties in water resources management that formerly were the responsibility of the Departments of Public Works and Conservation. These are in the areas of:

DISTURBANCE OF STREAM BEDS. The beds of certain streams may not be disturbed unless permission is granted by the Water Resources Commission (except under emergency conditions).

DREDGING AND FILL IN NAVIGABLE WATERS. Except for tidewaters bordering the counties of Nassau and Suffolk, any placing of fill, or excavating of soil, in the navigable waters of the State can be undertaken only after a permit is issued by the Water Resources Commission. Navigable waters are defined as publicly owned lakes, rivers and streams upon which vessels are operated.

CONSTRUCTION OF DAMS AND DOCKS. A permit must be secured from the Commission before undertaking the repair, construction or reconstruction of certain dams or docks.

RESEARCH IN WATER RESOURCES

In the past, research has provided invaluable basic data, and methods for using this data, to guide the better development of our water resources. The need for research continues today with greater intensity because of the growing concern in this area.

The Division of Environmental Health Services of the Department of Health investigates waste water treatment, plant design and operation, characteristics of sewage and industrial waste, as well as the assimilative capacities of streams and lakes throughout the State. Some of the specific research projects are:

A study of the efficiency and effectiveness of the operation of milk waste treatment plants.

The construction and operation of a pilot plant for treatment of wastes from cheese manufacturing.

A study of the treatment of wastes resulting from duck raising.

A study of methods to remove synthetic detergents from water.

A study of the concentration and movement of synthetic detergent wastes in ground waters.

A study of the treatment of organic wastes in aerated lagoons.

Initial studies of the chemical and microbiological factors affecting the water quality in Oneida Lake.

A study of the efficiency of commercially available treatment devices for boats equipped with marine toilets.

Evaluation of the extent and nature of pesticide and detergent intrusion in surface waters of a selected watershed.

The procedures for justifying the development of water resources require that monetary values be placed on the benefits to be accrued from any project. The Division of Water Resources, in cooperation with the Cornell Water Resources Center, is currently conducting a study to determine the economic impact of water-based recreation in a region. A pilot study is being made in the Finger Lakes area.

The following Division of Water Resources activities, although not true research, are data-gathering programs, closely resembling research:

The U.S.G.S., in cooperation with the Division of Water Resources, is currently engaged in a ten-year program to define the temporal and areal distributions of surface and groundwater, both quality and quantity. This program is scheduled for completion in 1975.

One challenge to the current technology is the use of water resources data collected at specific points in a broad regional planning program. The Division of Water Resources adapts and modifies various methods of data interpretation in a continuing review of technical developments.

APPENDIX I

HISTORY OF
WATER RESOURCES DEVELOPMENT
IN NEW YORK STATE

The start of construction of the Erie Canal in 1817 was the first chapter in the story of water resources development in New York State.

Although Governor DeWitt Clinton was ridiculed by many for his "big ditch," completed in 1825, the canal played a major role in the growth of the western United States. In fact, a U. S. Senate committee reported that it did more to advance the wealth, population and enterprise of the western states than all other causes combined. The canal eventually was widened, deepened and re-routed until it became the State Barge Canal System. (See Map D, page 40).

In the latter part of the 19th Century, New York State experienced widespread flooding. This led, in 1902, to establishment of the Water Storage Commission, the State's first agency for regulation of streams by water storage.

It was concerned primarily with flood control, and recommended that a permanent State agency regulate streams, with costs borne by the beneficiaries. This recommendation led to the creation, in 1904, of a River Improvement Commission. In its two years of operation, this agency made some investigations but produced few tangible results.

In 1905, the Water Storage Commission was superseded by the Water Supply Commission, largely as the result of fears of small communities. They felt that large communities, such as New York City, would condemn land for public use without regard to future water needs of the small communities. The new commission had jurisdiction over allocation of municipal water supplies. A year after its establishment this authority was extended to include the taking of water by private water companies. The Water Supply Commission also carried out extensive investigations into water power matters and it devised plans to develop water power for public use under State ownership and control. Three years later, in 1909, the agency's jurisdiction was extended again, this time to include the improvement of water courses at local expense.

In 1911 the Conservation Commission succeeded the Water Supply Commission and assumed responsibilities in the following areas:

NEW YORK STATE
BARGE CANAL SYSTEM
Lake Ontario
Lake Erie
Barge Canal
Barge Canal
Champlain Canal
Hudson River
Lake Champlain

Map D

Water storage and conservation for power purposes.

Hydraulic development.

River Improvement.

Drainage.

Water supply and sewerage.

Inspection and supervision of hydraulic structures.

Legislation in 1915 provided for the creation of river regulating districts under an unnamed commission. Four years later, the Black River Regulating District became the first district formed under this law. Nearly three decades later, in 1948, the State approved this district's plans to construct a dam on the Moose River at Panther Mountain to regulate the river's flow. This dam would have flooded forest preserve lands, which was permitted by the State Constitution at the time. An 1894 constitutional amendment had established the Forest Preserve and the principle that the Preserve be "forever wild." A 1913 amendment to this article authorized the Legislature to permit construction of reservoirs in the Forest Preserve for water supply purposes, for the canals of the State and to regulate the flow of streams. Despite this, there was strong opposition to the proposed Moose River reservoir, and by 1953 another constitutional amendment had eliminated the Legislature's power to authorize construction of river regulating reservoirs in the Forest Preserve. This amendment is still in effect.

TWO WATER POWER COMMISSIONS

The Commission created in 1915 without a name finally received a title in 1922 — Water Power Commission. But in the same year State power legislation, probably precipitated by the Federal Power Act of 1920, established the New York Power Commission. Thus the State had two Water Power Commissions. The first was concerned with river regulation. The other continued the surveys and studies of water power and storage possibilities. It also reviewed plans submitted by applicants for license to develop water power in streams where the State owned power rights.

In 1922, the water power agency that had been born without a name was retitled the Water Control Commission and was charged with administration of most parts of the Conservation Law relating to river improvement, river regulation, drainage of agricultural lands and water supply.

Finally, in 1926, the Water Control Commission and the New York Power

Commission were combined as the result of the formation that year of the State's Conservation Department. The newly merged organization was known as the Water Power and Control Commission. It consisted of the Conservation Commissioner as chairman, the Superintendent of Public Works and the Attorney General. To provide staff services for the new Commission, a Division of Water Power and Control was established within the Conservation Department.

THE POWER AUTHORITY IS ESTABLISHED

In 1931 the Power Authority of the State of New York was formed to develop hydro-electric power from boundary waters of the St. Lawrence River. Further legislation in 1951 permitted the Authority to develop the power resources of the Niagara River. This Authority was not the State's first venture into hydro-electric power development. In 1922, the legislature transferred the control of canal power sites from the Water Power Commission to the Superintendent of Public Works. At the same time it appropriated $1 million to build power plants at the Crescent and Vischer Ferry Dams, which were being constructed in conjunction with the Barge Canal System. The Superintendent of Public Works was empowered to sell any electric power not needed by the canal or State structures adjacent to the canal.

LEGISLATION TO PROTECT LONG ISLAND

In 1933 it was realized that the water table on Long Island had dropped dangerously because of overpumping by industrial and commercial wells, resulting in salt water intrusion. That year, wells with a capacity of over 100,000 gallons a day (which has since been changed to 45 gallons per minute) were placed under the jurisdiction of the Water Power and Control Commission. Two years later another law was passed requiring all well drillers on Long Island to obtain licenses and to report all wells installed.

THE DEVELOPMENT OF THE WATER RESOURCES COMMISSION

Serious flooding in 1935 was followed the next year by passage of the Federal Flood Control Act and a New York State law creating a Temporary State Commission for Flood Control. The Superintendent of the Department of Public Works acted for the State in obtaining federal flood relief under provisions of the federal act. This temporary agency remained in existence until 1960 when its functions, powers and duties were transferred to the newly-created Water Resources Commission.

In 1959 membership of the Water Power and Control Commission was enlarged to include the Commissioners of Health and of Agriculture and Markets. The jurisdiction of the Commission was extended to include multi-purpose, comprehensive water resources planning and development by Regional Boards.

In 1960 after lengthy study, the Legislature changed the Conservation Law provisions affecting water resources. The Division of Water Power and Control became the Division of Water Resources, and the Water Power and Control Commission became the Water Resources Commission.

This new commission was also assigned responsibilities originally given to other agencies. For example, it took over administration of county small watershed protection districts, which were made possible by enactment of the Small Watershed Protection and Flood Prevention Act in 1954. This responsibility originally had been vested in the Department of Agriculture and Markets.

The following year the Water Resources Commission was enlarged by the addition of the Commissioner of Commerce and four advisory members representing industry, political subdivisions, agriculture and the sportsmen of the State.

In 1962 the Water Pollution Control Board, which had been charged with the establishment of the stream classifications and policy in the water pollution control area, was abolished. Re-classification of streams and the determination of policy were assigned to the Water Resources Commission with the program implementation including abatement and enforcement assigned to the Commissioner of Health.

In 1965 the membership of the Commission was increased to seven by the addition of the Commissioner of the Office for Local Government.

The Water Resources Commission is now the State's chief organization for water resources planning and development. It is charged with formulation of policy and approval of programs of the operating departments and provides a point of focus for all water resources activities.

APPENDIX II

STATE LAW

1. Synopsis of Principles and Concepts

The underlying principle of New York's water policies, as indicated in the review which follows of this State's constitution, its statutes and case law, is that water is a natural resource, not to be conquered by man, but to be sought, recovered, processed, utilized, reclaimed, and reutilized.

a. State Constitution

The Constitution of the State of New York is the basic written law of the State.

Public Health - A Matter of State Concern

The Constitution provides that

> "The protection and promotion of the health of the inhabitants of the state are matters of public concern and provision therefor shall be made by the state and by such of its subdivisions and in such manner, and by such means as the legislature shall from time to time determine." (Article 17, Sec. 3.)

Financing of Sewage Treatment Works, Water Supplies

The Constitution enables counties, cities, towns and villages in New York State to meet one of the truly major problems of a heavily populated state in financing sewage treatment facilities, drainage systems, and water supplies.

Article 8, Sec. 2-a of the Constitution provides that the legislature by general or special law may authorize any county, city, town or village or any county or town on behalf of an improvement district to contract indebtedness: to provide a supply of water, in excess of its own needs, for sale to any other public corporation or improvement district; to provide facilities, in excess of its own needs, for the conveyance, treatment and disposal of sewage from any other public corporation or improvement district; to provide facilities, in excess of its own needs, for drainage purposes from any other public corporation or improvement district.

Article 8, Sec. 2-a of the Constitution also provides that the legislature by general or special law may authorize two or more public corporations and improvement districts to provide for a common supply of

water, for the common conveyance, treatment and disposal of sewage, for a common drainage system and to contract joint indebtedness for these purposes.

Article 8, Sec. 2-a further provides that debts contracted pursuant to that article shall be excluded from the constitutional limitation of indebtedness imposed on municipalities.

In order to encourage and stimulate local action by municipalities, New York State voters in 1963 overwhelmingly approved a referendum removing constitutional debt limitations to cover the costs of building sewage treatment plants. The exemption, which began January 1, 1964, covers any sewage facilities contracted for by a municipality during the eleven year period between January 1, 1962 and December 31, 1972 (Article 8, Sections 5E and 7).

Forest Preserve

A constitutional amendment of 1894 established the forest preserve and mandated that "The lands of the State * * * constituting the forest preserve as now fixed by law, shall be forever kept as wild forest lands." (Article 14, Section 1.)

An amendment of 1913 to Article 14 provides that

> "The legislature may by general laws provide for the use of not exceeding three per centum of such lands (forest preserve) for the construction and maintenance of reservoirs for municipal water supply, and for the canals of the state. Such reservoirs shall be constructed, owned and controlled by the state, * * * and the expense of any such improvements shall be apportioned on the public and private property and municipalities benefited." (Article 14, Section 2.)[1]

Drainage

The Constitution provides that general laws may be passed permitting owners or occupants of swamp or agricultural lands to construct and maintain necessary drains, diversions and dikes upon the lands of others for drainage purposes, under proper restrictions and on making just compensation. (Article I, Section 7(d).)

Barge Canal System

The Constitution also provides that the legislature may authorize by

1. See also Conservation Law, Sections 460-466, 618.

law the lease or transfer to the Federal government of the barge canal system (Article 15, Section 4).

b. Statutes

1. WATER POLLUTION CONTROL LAW

Background and Public Policy

Beginning in 1902, this State's water resources control laws began to evolve. The early legislation delegated separate areas of the State's water resources to the Conservation Department, the Health Department and the Public Works Department. As early as 1903 the legislature enacted its first water pollution control law.[2]

The experience of these Departments in administering their concurrent regulatory functions in the field of water resources demonstrated a need for a broad-based, multi-purpose program that would unite the interests of the various State administrative units into a "concert of cooperation."

This copartnership between the different agencies of the State was achieved with the enactment of the Water Pollution Control Law of 1949 (Public Health Law, Article 12).

Public Health Law, Article 12, declares that it is the public policy of the State of New York (Section 1200):

> "to maintain reasonable standards of purity of the waters of the state consistent with public health and public enjoyment thereof, the propagation and protection of fish and wild life, including birds, mammals and other terrestrial and aquatic life, and the industrial development of the state, and to that end require the use of all known available and reasonable methods to prevent and control the pollution of the waters of the state of New York."

The purpose of Article 12 is (Section 1201):

> "to safeguard the waters of the state from pollution by: (a) preventing any new pollution, and (b) abating pollution existing when this chapter is enacted, under a program consistent with the declaration of policy above stated in the provisions of this article."

2. "Water Resources Management - Six Year Progress Report" Temporary State Commission on Water Resources Planning, Leg. Doc. (1965) No. 27, p. 34.

Administrative Procedure

By this law the Water Resources Commission[3] is required to adopt standards of quality and purity and to classify the State's waters in accordance with considerations of "best usage" in the public interest.[4] The "Rules and Classifications and Standards of Quality and Purity for Waters of New York State" were duly adopted.[5]

Pursuant to Public Health Law, Section 1205, the Commission's procedure is as follows:

1. A classification survey is made on the basis of drainage-basin areas, including all sub-basins and tributaries to a major drainage outlet.
2. A report of the survey is published containing tentative classifications recommended by the Commission's staff.
3. The tentative classifications are discussed at public hearings held at convenient locations within the drainage area.
4. Classifications are adopted by the Commission. The Commission may modify tentative classifications as a result of the hearing, but once the waters have been classified,

> "it shall be unlawful for any person, directly or indirectly, to throw, drain, run or otherwise discharge into such waters organic or inorganic matter that shall cause or contribute to a condition in contravention of the standards adopted by the water resources commission pursuant to section one thousand two hundred five of this article." (Public Health Law, Section 1220.)

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3. The Water Resources Commission now consists of seven regular members: the Commissioners of the State Departments of Health, Conservation, Agriculture and Markets, Commerce, Office for Local Government, the Superintendent of Public Works, and the Attorney General and four advisory members representing industry, political subdivisions, agriculture and sportsmen of the State. (Conservation Law, Section 410.) Chapter 663 of the Laws of 1965 increased the number of regular members from six to seven by adding the Commissioner for Local Government.

4. See Conservation Law, Section 427.

5. These rules were originally adopted by the Water Pollution Control Board and were subsequently readopted by the Water Resources Commission. (See Public Health Law, Section 1205, subd. (7) (a); N.Y.C.R.R., 6th Off. Supp., 1951, p. 208, et seq.)

5. Development of comprehensive pollution abatement plans. The plan consists of a description of each pollution problem within the area and the procedure to be followed in each instance to comply with the classification. Reports of progress in achieving compliance are required, and a reasonable time for correction is provided.
6. The comprehensive plan is then enforced by the Department of Health. Initially, cooperation on a voluntary basis is sought but if the results are unsatisfactory then the Department of Health, in accordance with its administrative procedures, conducts public hearings prior to the issuance of formal enforcement orders (Public Health Law, Section 1210). If voluntary compliance with the order of abatement is not achieved, the Commissioner of Health is authorized to request the Attorney General to institute appropriate court proceedings to compel compliance (Public Health Law, Section 1251).

The Department of Health is given administrative jurisdiction to abate and prevent the pollution of waters of the State. The Commissioner of Health is granted broad authority, powers and duties to effectuate the provisions of Article 12. Acting through the Commissioner, the Department of Health may adopt, amend or cancel administrative rules and regulations governing hearings, filing of reports and issuance of permits (Public Health Law, Section 1210).

Persons are required to apply for permits to the Commissioner, or his designated representative, for permission to discharge sewage or industrial wastes through new outlets or to construct or operate and use new disposal systems. (Public Health Law, Sections 1230, 1231, 1232.)[6]

In enforcing the comprehensive plan "public hearings shall be conducted by the (Health) commissioner, or his duly designated representative * * * prior to issuance of an order directing any person to discontinue discharge of sewage, industrial waste or other wastes which contravene the standards established for any waters of the State." (Public Health Law, Section 1240; see also Sections 1241, 1242, 1243.)

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6. Public Health Law, Section 1225, provides that the minimum degree of treatment required for the discharge of sanitary sewage into the classified surface waters of the State shall be effective primary treatment.

In 1965, the State Legislature amended the Public Health Law, concerning existing discharges of sewage and industrial wastes, by streamlining the administrative hearing procedures before the Department of Health (Laws of 1965, Chapter 180). Under Public Health Law, Section 1223, as amended, the Commissioner shall consider, among other matters, evidence at the hearing relating to:

(a) The adequacy and practicability of various means of abating the polluting content of such discharge;

(b) The financial ability of the polluter to so abate;

(c) The engineering impossibility or impracticability to abate immediately such discharge.

After the hearing, if the Commissioner finds financial inability, engineering impossibility or impracticability to abate immediately the discharge, his order shall establish the reasonable time or times within which the required steps are to be taken. The order of the Commissioner is absolute upon entry and service.

An aggrieved person may seek a review of the order or determination of the Commissioner of Health either by the courts or by the Water Resources Commission. However, the institution of a judicial proceeding to review such determination or order of the Health Commissioner shall preclude a review by the Water Resources Commission. (Public Health Law, Sections 1244, 1245, as amended by Laws of 1965, Chapter 180.)

Public Health Law, Section 1251, states:

> "It shall be the duty of the attorney general upon the request of the water resources commission or of the commissioner to bring an action for an injunction against any person violating the provisions of this article, or violating any order or determination of the water resources commission or of the commissioner. In any action for an injunction brought pursuant to this article, any finding of the water resources commission or of the health commissioner or hearing officer or panel appointed and designated by the commissioner shall be prima facie evidence of the fact or facts found therein."

Violators are liable to the payment of a penalty in a civil action brought by the Attorney General (Public Health Law, Section 1250) and wilful violations are punishable by criminal liability in the form of imprisonment or a fine or by both fine and imprisonment (Public Health Law, Section 1252).

Financial Assistance

New York State has pioneered in programs for State aid for comprehensive studies and reports concerning the collection, treatment and disposal of sewage by municipalities (Public Health Law, Section 1263-a); aid for construction of sewage treatment works (Public Health Law, Section 1263-b, as amended by Laws of 1965, Chapter 177) and State assistance for municipal operation and maintenance of sewage treatment works. (Public Health Law, Section 1263-c.)[7]

The culmination of New York State's efforts was realized in 1965 when a unanimous State Legislature submitted to the electorate a proposition authorizing creation of a State debt in the amount of a one billion, seven hundred million dollar bond issue to provide monies to combat water pollution by the construction of sewage treatment facilities. The voters of New York State by an overwhelming vote of four to one approved the proposition.

The law is called the Pure Waters Bond Act (Laws of 1965, Chapter 176). Governor Rockefeller outlined a seven-point clean waters program:

1. State leadership in federal-state-local sharing of the cost of constructing new sewage treatment plants and interceptor sewers. The State and the Federal governments each assumes thirty per cent of the construction costs and the local communities assume forty percent of such costs. The one billion seven hundred million dollar bond issue will be used to pay the State's share and prefinance the Federal share, if necessary. (Laws of 1965, Chapters 176 and 177.)
2. Industrial incentives in the form of real property tax exemption for the entire added value of pollution control equipment (Laws of 1965, Chapter 179) and a tax reduction for expenditures in constructing or improving waste treatment facilities. (Laws of 1965, Chapter 178.)

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7. Other recent examples of action by the State are the Laws of 1965, Chapter 481, which amends the Town Law and empowers town boards to provide for excess sewer facilities; Laws of 1965, Chapter 560 which creates the Hudson River valley scenic and historic corridor; and Laws of 1965, Chapter 661, which authorizes projects relating to the use of atmospheric water resources.

3. State and Federal action to eliminate water pollution by government institutions in New York State. (Laws of 1965, Chapter 853.)
4. State aid to localities for one-third of the cost of operating and maintaining local sewage treatment plants. (Public Health Law, Section 1263 (c).)
5. An automated monitoring system for surveillance of the quality of the waters in our principal rivers.
6. An expansion of State research in water pollution control methods. (Laws of 1965, Chapter 681.)
7. Vigorous enforcement of the State's laws against water pollution. (Laws of 1965, Chapter 180.)

Aside from its jurisdiction to abate and prevent pollution of the waters of the State, the Department of Health enforces the provisions of the State Sanitary Code pertaining to drinking water supplies, swimming pools and bathing beaches. (State Sanitary Code, 10 N.Y.C.R.R. Chapter 1.) The Department is also required to give its initial approval to the establishment of sewage disposal corporations by municipalities under Article 10 of the Transportation Corporation Law.

The Department of Health is responsible for the sanitary aspect of public water supplies (Public Health Law, Article II, Titles I, II and III). The Department may make rules and regulations for the protection from contamination of public water supplies, conduct investigations, and in any court of competent jurisdiction may enforce prompt compliance with the orders of the Commissioner (Public Health Law, Sections 1100, 1101, and 1107).

2. WATER RESOURCES LAW

While an outstanding beginning had been made in bringing together the interests of various State administrative units in the water pollution control program, this copartnership of governmental action was limited initially to one facet of the manifold problems of water resources, namely, quality control.

The present concept of partnership participation that would weave the water pollution abatement program into the "whole fabric" of water resources management, planning, development, conservation, and water utilization finally evolved. The new era in water resources management began in New York State in 1960 when the Conservation Law was revised and a new Article V, called the Water Resources

Law, was passed by the Legislature.

The "Declaration of Policy" in Article V of the Water Resources Law sets the course to be followed by the State. It declares that the sovereign power to regulate and control the water resources of this State has been and now is vested exclusively in the State of New York, except to the extent of any delegation of power to the United States. It is

> "declared to be the public policy of the state of New York, in recognition of its sovereign duty to conserve and control its water resources for the benefit of all inhabitants of the state, that comprehensive planning be undertaken for the protection, conservation and development of the water resources of this state to the end that they shall not be wasted and shall be adequate to meet the present and future needs for domestic, municipal, agricultural, commercial, industrial, recreational and other public, beneficial purposes.
>
> (3) It is further declared to be the public policy of the state of New York that
>
> (a) the acquisition, storage, diversion and use of water for domestic and municipal purposes shall have priority over all other purposes; and
>
> (b) in addition to other recognized public beneficial uses and control of water as provided by this Article V or by any other statute, the regulated acquisition, storage, diversion and use of water for the supplemental irrigation of agricultural lands within this state is a public purpose and use, in the interests of the health and welfare of the people of the state and for their interest." (Conservation Law, Section 401.)[8]

The Water Resources Commission is the administrative agency charged with the responsibility of administering the Water Resources Law (Conservation Law, Section 410). The general jurisdiction of the Commission is to

> "exercise its powers and perform its duties in any matter affecting the construction of improvements to or developments of water resources for the public health, safety or welfare, including but not limited to the supply of potable waters for the various municipalities and inhabitants thereof, the use of water for industrial and agricultural operations, the developed and undeveloped water power of the state,

8. The "Legislative Findings" set forth in Laws of 1960, Chapter 7, are to be considered in the construction and administration of Article V of the Conservation Law.

the facilitation of proper drainage and the regulation of flow and improvement of the rivers of the state." (Conservation Law, Section 404.)

To exercise effectively its broad statutory powers and duties, the Commission in Article V is granted the right to make investigations (Section 420), the power of eminent domain (Section 423), the power to sue (Section 421), the right of access to any property, public or private, to investigate conditions (Section 422), the right to examine books, records and accounts (Section 424) and the power to compel the filing of reports with it (Section 425). The Commission, to protect the interests of the State, is authorized to cooperate with appropriate agencies of the Federal government and with other governmental bodies and agencies (Section 426).

The Water Resources Commission "may adopt rules in conformity with the statute governing the procedures prescribed or authorized by Article V" (Section 430). In administering its quasi-judicial functions, the Commission must act in accordance with the hearing procedures set forth in Section 431 of the Conservation Law. The right of judicial review is governed by Section 432.

There is no doubt that the Water Resources Commission was created "to integrate all policy-making and planning activities of the State with respect to water resources." (Section 410). The Commission may undertake comprehensive planning for the protection, control, conservation, development and beneficial utilization of the water resources of the State (Section 435). Article V, Part V of the Conservation Law introduces a new, modern concept of regional water resources planning and development on broad multi-purpose, regional, basin-wide dimensions.

In order to stimulate and encourage local participation and cooperation, the Water Resources Commission is empowered to approve petitions from counties, cities, towns or villages to create Regional Water Resources Planning and Development Boards to carry out studies and planning work at the local level, under the technical guidance of the Commission (Conservation Law, Sections 436, 437). The State grants seventy-five per cent of the cost of carrying such local planning programs (Section 440). To further encourage local participation, the Conservation Law provides for State grants to cover the entire cost of preparation of comprehensive area-wide public water supply systems studies and reports (Conservation Law, Section 446 and Article V, Part V-A).

Not only in the field of water resources planning but also in the equally important field of water resources management, the Water Resources Commission acts as

the clearing house for virtually all water resources matters in the State.

The broad scope of the Commission's general jurisdiction is indicated by the following statutory responsibilities:[9]

(a) Water Supply — Conservation Law, Article V, Part VI, Sections 450-480. Apportionment of the water supply resources of the State among the inhabitants of the State. This includes licensing of well drillers on Long Island (Section 475) and the control of commercial and industrial wells on Long Island (Section 476).

(b) Water Power — Conservation Law, Article V, Part VII, Sections 500-524. In regard to hydroelectric power projects, the Commission is charged with licensing, fixing, and collection of rental for certain water used for the generation of power.

(c) Drainage — Conservation Law, Article V, Part VIII, Sections 530-575. Drainage improvement districts are authorized to provide for drainage of agricultural lands with prescribed procedures for condemnation of rights of way for drainage outlet ditches.

(d) River Regulation — Conservation Law, Article V, Part IX, Title A, Sections 580-600.[10] River regulating districts may be created upon the approval of the Commission for the purpose of constructing storage reservoirs to regulate the flow of a stream or river.

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9. The jurisdiction of the Water Resources Commission has been further enlarged by the passage of the Stream Protection Law (Laws of 1965, Chapter 955) effective on January 1, 1966. This bill repeals and amends various sections of the Conservation Law in an effort to better protect and control the use of certain streams of the State of New York and inserts a new part, to be Article V, Part III-A of the Conservation Law.

10. The Hudson River Regulating District and the Black River Regulating District were consolidated into a single district to include the areas of both such districts, to be known as the Hudson River-Black River Regulating District and a new board was created under that name (Conservation Law, Sections 598, 599, 600).

(e) River Improvement — Conservation Law, Article V, Part IX, Title B, Sections 610-620. River improvement districts may be created upon the approval of the Commission for the purpose of initiating projects to improve the channel, construct dikes, or regulate the flow of a river for protection from damage by floods. The governing body of the district is the Commission.

(f) Joint River Regulating, River Improvement and Drainage Improvement Districts — Conservation Law, Article V, Part IX, Title C, Sections 625-627. A river regulating district may be given extended powers and duties if joined together with a river improvement district or drainage improvement district, or both. The joint districts are subject to the general supervision of the Commission.

(g) Pollution Control — Public Health Law, Article 12. Under the Public Health Law the Commission is required to adopt standards of quality and purity and to classify the State's waters in accordance with considerations of "best usage" in the public interest. An aggrieved person may seek a review of the order or determination of the Commissioner of Health by the courts or by the Commission.

(h) County Small Watershed Protection Districts — County Law, Article 5-D. Provision is made for state aid to counties for construction costs of flood prevention work in conjunction with federal aid available under the "Watershed Protection and Flood Prevention Act" (P.L. 566). The responsibility for initiating, planning, constructing and the operation and maintenance of projects under this Act is vested in county governments.[11]

11. Laws of 1965, Chapter 779, amends the County Law in relation to State aid for flood prevention and erosion control.

(i) Flood Control Projects — Laws of 1936, Chapter 862; McKinney's Unconsolidated Laws, Title 4, Chapter 1, Sections 1301-1310. The Commission, as successor in interest to the temporary state flood control commission, assists in the institution and consummation of the federal program of flood control.

The Division of Water Resources of the Conservation Department provides certain staff services to the Commission, makes certain studies and investigations, and performs such other duties and functions as may be assigned to it by the Commission. (Conservation Law, Article 6, Title I, Sections 6-0101, 6-0105; Laws of 1965, Chapter 678.)

3. STATUTES RELATING TO OTHER DEPARTMENTS, WATER DISTRICTS AND INTERSTATE WATER COMPACTS

A. Department of Public Works

The Department is responsible for planning, constructing and maintaining waterways, including the canal system and flood control facilities (Canal Law, Section 40; Public Works Law, Section 8). Waterway activities include the operation of locks upon the canal system, dredging, bank repair, maintenance of navigation and safety aids, and other maintenance activities upon the waterways themselves.

Section 5 of Chapter 862 of the Laws of 1936 as amended provides: "The Superintendent of Public Works is hereby authorized and directed for and in behalf of the State to carry out the State's participation in a federal program of flood control, to sign all necessary agreements, and to do and perform all necessary acts in connection therewith to consummate the intent and purpose running with the approval by the federal government of flood control projects in New York State and the allotment of moneys for such projects, if, as and when made by the federal government." After policy approval of projects by the Water Resources Commission, the Superintendent of Public Works executes agreements with the federal government assuring State responsibility for non-federal participation as required. The Department of Public Works assumes maintenance responsibility for the majority of projects.

The Superintendent of the Department had control of structures for impounding waters, dams and docks (Conservation Law, Section 948). However, Chapter 955 of the Laws of 1965, which became effective January 1, 1966, repealed Conservation Law, Section 948, and placed jurisdiction over the protection of streams, dams and

docks, and structures for impounding waters with the Water Resources Commission. (The statute will be contained in a new Part III-A of Article V of the Conservation Law.)

B. Office of General Services

The Commissioner of General Services may grant to adjacent owners, in the exercise of his sound discretion, State lands under water to promote the commerce of the State or for the purpose of beneficial enjoyment by such owners or for agricultural purposes, or for public park, beach, street, highway, parkway, playground, recreation or conservation purposes.

The Commissioner may authorize the use and occupation by the United States of lands of the State under water, for the purpose of improvement of navigation, including sites for lighthouses, beacons, navy yards and naval stations (Public Lands Law, Section 75, subds. 7 and 8).

If, after investigation and report by the Superintendent of Public Works to the Attorney General, it appears that a grantee has failed to comply with the conditions of the grant, it shall be the duty of the Attorney General to bring an action for the annulment of the grant (Public Lands Law, Section 78).

C. Department of Public Service

In regard to privately owned water utilities throughout New York State, the Public Service Commission approves stock issues and transfers of property, reviews books and records, determines the original cost of property and approves rates and charges. Staff members inspect and test water plants and equipment for safe and adequate service, make engineering studies of efficiency of operation, investigate complaints and inspect for compliance with Commission orders. They also advise water companies on operation and rate problems. (Public Service Law, Article 4-B, Sections 89-a to 89-o.)

D. Power Authority of the State of New York

The Authority was created by legislative enactment in 1931 as an agency of the State to develop the available hydroelectric power resources. The Public Authorities Law declares those parts of the Niagara and St. Lawrence Rivers within the boundaries of the State to be natural resources of the State for the use and development of commerce and navigation in the interest of the people of this State and the United States. The statute establishes the Power Authority of New York State for the purposes of providing for the most beneficial use of these natural resources, preserving and enhancing the scenic beauty of the Niagara Falls and River and for the purpose of improving the Niagara and St. Lawrence Rivers as instrumentalities of

commerce and navigation and developing the hydroelectric power resources of the two rivers. (Public Authorities Law, Article 5, Title 1, Sections 1000-1016.)

E. Local Water Supply, Sewer and Drainage Districts

Cities, counties and towns may establish water supply, sewer and drainage districts. The various statutes specify the local agencies which administer them (General City Law, Section 20; County Law, Article 5-A, Sections 250-276; Town Law, Article 12, Sections 190-208-a).

F. Soil and Water Conservation Districts

The Soil and Water Conservation Districts Law permits the board of supervisors of any county to create a county soil and water conservation district when soil erosion and related problems are of sufficient concern to the public (Soil and Water Conservation District Law, Sections 5, 9).

G. Interstate Water Compacts:

The State of New York is a party to the following interstate water compacts:

1. Delaware River Basin Compact

   Conservation Law, Article VII, Title I, Sections 801-812. This compact, between the federal government and the States of New York, New Jersey, Pennsylvania, and Delaware, established an intergovernmental commission known as the Delaware River Basin Commission, which is charged with the comprehensive planning, development and management of the water and related land resources of the Delaware River Basin.

2. Great Lakes Basin Compact

   Conservation Law, Article VII, Title II, Sections 815-822. The Great Lakes Commission includes the States of Illinois, Indiana, Michigan, Minnesota, New York, Ohio, Pennsylvania and Wisconsin and exercises powers and functions in respect to the Great Lakes Basin.

3. Atlantic States Marine Fisheries Compact

   Conservation Law, Article IV, Section 325. Includes the following States along the Atlantic seaboard: Maine, New Hampshire, Massachusetts, Rhode Island, Connecticut, New York, New Jersey, Delaware, Maryland,

Virginia, North Carolina, South Carolina, Georgia and Florida.

4. New England Interstate Water Pollution Control Compact

   Public Health Law, Article 11-A. The compact includes the States of New Hampshire, Connecticut, Vermont, Rhode Island, Maine, Massachusetts and New York.

5. Ohio River Valley Water Sanitation Compact

   Public Health Law, Article 11-B. This compact includes the following States: Illinois, Indiana, Kentucky, New York, Ohio, Pennsylvania, Tennessee, Virginia and West Virginia.

6. Tri-State Compact and Interstate Sanitation Commission

   Public Health Law, Article 12-B. This compact includes the States of New York, New Jersey and Connecticut.

c. Case Law

The State of New York has the duty

> "to control and conserve its water resources for the benefit of all the inhabitants of the State. The public right to the benefit of such resources is an incident of sovereignty. The Legislature, when acting within constitutional limitations and in the interest of the public, may, at will, grant, withhold, or condition the privilege to a municipality of taking water from a public source. The Legislature may delegate the performance of its duty to an agency or commission, but the agency can act only within the scope of the powers delegated expressly or by necessary implication to enable it to carry out the powers expressly given." (Matter of City of Syracuse v. Gibbs, 283 N. Y. 275, 283, 28 N.E. 2d 835 (1940).)

The Legislature in 1949, when it enacted the Water Pollution Control Law, and once again in 1960 when it enacted the Water Resources Law, did "delegate the performance of its duty to an agency or commission". The following discussion concerns significant court decisions construing and interpreting the Water Pollution Control Law and the Water Resources Law.

A leading New York case in the field of pollution control is Matter of City of

Utica v. Water Pollution Control Board, 5 N. Y. 2d 164, 156 N. E. 2d 301 (1959), which upheld the constitutionality of Article 12 of the Public Health Law.

The City of Utica brought a proceeding to restrain the Water Pollution Control Board from conducting a hearing in respect to the City's alleged violations of Article 12 of the Public Health Law. The lower Court dismissed the petition and the City appealed on the grounds that the Water Pollution Control Law constitutes an invalid delegation of legislative authority and an invalid grant of power, without adequate standards for the Board's guidance, in violation of the State Constitution (Article III, Section 1).

The Court of Appeals held that the abatement and prevention of water pollution is a matter of State concern and legislation designed to regulate and control such pollution is within the scope of the State's police power. It further held that the Water Pollution Control Law was a constitutional and valid delegation of legislative power. The Court said (p. 170):

> "Having clearly expressed the policy underlying the law, the Legislature was privileged to leave to the Board the power to decide what properties indicate a polluted condition of a particular class of waters and to assign the appropriate classification to any water of the State. Such a power is no more than one to make subordinate rules and determine the facts to which the legislative policy is to apply. In other words, the Legislature is not required to break its plan down into fine detail in order to carry through its purpose of safeguarding the waters of the State."

The Court stated further (p. 171):

> "Having in mind the breadth of the problem of water pollution control, its technical and intricate character, the Legislature could hardly have been more specific in prescribing essential guides * * *. To insist upon more precise standards than furnished by the statute before us would be tantamount to declaring that the Legislature's power to control pollution of the State's waters could not be effectively exercised."

In Matter of Town of Waterford, et al. v. Water Pollution Control Board, 5 N. Y. 2d 171, 156 N. E. 2d 427 (1959), the Water Pollution Control Board had assigned the classification "C" to the waters of the Mohawk River on which the Town and Village of Waterford bordered. The effect of the "C" classification was to require those municipalities to construct sewage treatment facilities.

In a proceeding to review the Board's determination, the Town of Waterford contested the classification on the grounds that the Board failed to comply with the

standards prescribed by Public Health Law, Section 1209 (now Section 1205); that the Board failed to give any consideration to the fiscal cost and tax burden which enforcement of the assigned classification would impose and that the classification constituted an economic hardship rendering impossible expenditures for other public improvements.

The Court of Appeals held that the Town of Waterford was premature in seeking to raise fiscal considerations at the time of classification. The Court said (p. 179):

> "There is nothing in the statute that requires the Board to consider probable costs or relative priorities as between municipal public works projects, at the time it adopts a classification for particular waters."

Furthermore, the Court held that the legislature when it enacted Public Health Law, Section 1224, was fully cognizant of cases involving financial hardship and expressly provided for extensions of time in such situations.

The Town of Waterford also contended that the statutory provision for a public hearing contemplated that witnesses be sworn, testimony be taken, opportunity for cross-examination be given, and findings of fact be made. The Court of Appeals ruled that the procedures followed by the Board were proper and sufficient in the circumstances and stated (p. 184):

> "By thus making specific provision for a quasi-judicial type of hearing with respect to violations of the statute or orders of the Board, in contrast with the general requirement of a public hearing in connection with adopting water classifications, the Legislature in effect distinguished between the different types of public hearings which the Board was required to hold, and impliedly sanctioned the informal type of hearing conducted here. A judicial type of hearing would, of course, be appropriate when punishing individual violations, while it would be manifestly inappropriate in connection with the adoption of a water classification affecting many municipalities, individuals and industries."

The above decision was followed in Matter of Frost White Paper Mills, Inc. v. Harold G. Wilm, et al. constituting the Water Resources Commission, 45 Misc. 2d 123, (Sup. Ct., Albany County, 1964) 255 N. Y. S. 2d 697.

In Matter of the City of Johnstown v. Water Pollution Control Board, 12 A. D. 2d 218 (3rd Dept., 1961), 209 N. Y. S. 2d 982, the City of Johnstown argued that the Board had no power to classify Cayadutta Creek because it is a non-navigable stream, the title of which is in private riparian owners and that the power of the Board to

classify is limited to "waters of the State."

The Court citing Public Health Law, Section 1202, subd. (b), held that it has become settled law that "waters of the State" include all fresh waters in streams, both public or private.

The Water Resources Law, Article V of the Conservation Law, gives broad regulatory powers over the public water supplies of the whole State to the Water Resources Commission.

The case of Great Neck Water Authority v. Citizens Water Supply Company of Newtown, 12 N. Y. 2d 167, 187, N. E. 2d 786 (1962), illustrates the principle that the Commission's broad regulatory powers extend to existing public water supply systems.

The plaintiff Authority, a public benefit corporation, brought a condemnation proceeding against the defendant Company to acquire its existing water supply system. The defendant Company moved for summary judgment on the ground that the Authority, before commencing its condemnation proceeding, had not obtained the prior approval of the Water Resources Commission for the taking.

The Court granted the motion and held that although this case involved a transfer of ownership of an existing water supply system, nevertheless, prior approval by the Water Resources Commission was a prerequisite to the bringing of the condemnation proceeding. The Court stated (pp. 174-175):

> "Although the phrase 'water supply' is not defined in the statute, it reasonably includes such a complex of lands, waters thereunder, structures and equipment as is owned by Company and used by it in selling water to the public. Section 450 thus requires permission for the taking of a water supply owned by an existing corporation as well as for the acquisition of an additional water supply from an existing approved source or of lands for a new or additional water source or the utilization thereof. * * * Such a construction of the Conservation Law is necessary to carry out the legislative purpose of giving the Water Resources Commission broad regulatory powers over the potable water supply of the whole State (see Conservation Law, Sections 435, 450, 451). * * * The over-all regulatory purpose cannot be achieved unless such determinations are made as to sales of existing facilities as well as the setting up of new ones."

River regulating districts may be created by order of the Water Power and Control Commission (now the Water Resources Commission) as an agency of the State subject to the control of the legislature, for the sole public purpose of con-

structing storage reservoirs for river regulation. Black River Regulating District v. Adirondack League Club, 307 N. Y. 475, 121 N. E. 2d 428 (1954); app. dism. 76 S. Ct. 780, 351 U. S. 922, 100 L. Ed. 1453 (1956).

Matter of Suffolk County Water Authority v. Water Power and Control Commission, 12 A.D. 2d 198 (3rd Dept., 1961), 209 N.Y.S. 2d 978, concerns the problem faced by the Water Resources Commission of allocating authority between two competing public water supply agencies to serve a given territory.

The Commission initially approved a proposal by the Suffolk County Water Authority to extend its service area. The Commission's order reserved "the right to alter the boundaries of this area; to authorize the construction of other water works systems therein, both publicly and privately owned; and to authorize the development of other sources of water supply, both within and without said area for the supply of water in said area."

Subsequently, the Commission approved an application of the Town of Huntington to authorize extension of a town water district into a relatively small portion of the same territory previously approved to be serviced by the Suffolk County Water Authority.

The issue was the legal right of the Water Power and Control Commission (now the Water Resources Commission) to rearrange its formal approval and authorization given to the original plan of the Suffolk County Water Authority. The Court confirmed the Commission's power to make such a change and said (p. 202):

> "The problem of allocation of authority to serve a given territory is one involving an advised and specialized administrative judgment which must take into consideration a balancing of the needs of existing areas served, the contiguous or remote relationship of facilities to service; the geographic symmetry and arrangement of the territory in the light of present and future needs; the probable growth of territory; the nature and interests of the public and governmental agencies concerned; the available water; and a number of other related questions.
>
> "The broad responsibility to make determinations affecting the access to water resources of the State rests by law in the commission (Conservation Law, art. 5 (Water Resources Law)). * * *."

The above decision was followed in New Highway Water Works Co., Inc. v. Water Resources Commission, 14 A. D. 2d 973 (3rd Dept., 1961), 221 N. Y. S. 2d 459.

Section 451 of the Conservation Law requires that any plan for new or addi-

tional sources of water supply must meet the following standards: it must be justified by public necessity; it must be just and equitable to affected municipalities and people; and it must make fair and equitable provisions for the determination and payment of all legal damages.

The following cases discuss the application of these statutory standards: New Highway Water Works Co., Inc. v. Water Resources Commission, 14 A. D. 2d 973 (3rd Dept., 1961), 221 N. Y. S. 2d 459; Great Neck Water Authority v. Water Resources Commission, 22 A. D. 2d 78 (3rd Dept., 1964), 253 N. Y. S. 2d 754; Rockland County Anti-Reservoir Ass'n v. Duryea, et al., 282 A. D. 457 (3rd Dept., 1953), 123 N. Y. S. 2d 445; Spring Valley Water Works and Supply Company v. Wilm, et al., constituting the Water Power and Control Commission, 14 A. D. 2d 658 (3rd Dept., 1961), 218 N. Y. S. 2d 800.

d. Attorney General's Opinions[12]

1. "Public Water Supply" Construed

A water supply from a private well conveyed through pipes by a pumping system to from twelve to fifteen houses is a "public water supply" within the meaning of Section 88 of the Public Health Law, notwithstanding the fact that the water is furnished without charge.

1935 Op. Atty. Gen. 365

2. Lake Levels - Saranac, Tupper and Kushaqua - Right of Department of Public Works to Permit a Lowering of the Levels

The Department of Public Works has no authority to permit the levels of Saranac, Tupper, and Kushaqua Lakes to be lowered or interfered with.

1942 Op. Atty. Gen. 233

3. Canal Law, Sections 10, 100; Conservation Law, Sections 614-619; Authority to Permit Construction of Flashboards; Authority to Charge for Use of Surplus Waters

The Superintendent of Public Works has general supervision of the canal system and may permit construction of flashboards on dam if beneficial to the canal system (Canal Law, Section 10, subds. 1, 9 and 25). A license to use surplus canal water may be granted by the Water Power and Control Commission with the approval of the Superintendent of Public Works, pursuant to the provisions

12. For additional opinions of Attorney General, see Cumulative Index 1940-1942 and Index for 1963-1964.

of Conservation Law, Sections 614-619 inclusive and a charge may be made therefor.

1944 Op. Atty. Gen. 316

4. Flood Control

There is no constitutional objection to use of condemnation power by State to acquire Indian reservation lands necessary for a flood control project, but specific legislation is recommended.

1944 Op. Atty. Gen. 376

5. Conservation Law, Water Supply

The Water Power and Control Commission (now the Water Resources Commission) does not have retained jurisdiction to render a decision requiring the City of Utica to install mains in a Water Supply District for fire protection purposes.

1954 Op. Atty. Gen. 160

6. Conservation Law, Water Supply

Water Power and Control Commission (now the Water Resources Commission) lacks jurisdiction to approve plans of foreign municipal corporation to take and acquire an additional water supply in this State for use in other states.

1955 Op. Atty. Gen. 183

7. General Corporation Law, Section 3; Town Law, Article 12 — Water District — Not a Public Corporation

A water district subject to Town Law, Article 12, has no authority to contract indebtedness and, therefore, is not a public corporation as defined by General Corporation Law, Section 3.

1959 Op. Atty. Gen. 238

8. Public Lands Law, Section 3

Commissioner of General Services may license and regulate the taking of materials in State lands under water, but this does not include that part of the bed of Cattaraugus Creek forming the southerly boundary of Erie County nor the bed of Lake Erie bordering Chautauqua County, nor is such action authorized under Conservation Law, Section 179.

1963 Op. Atty. Gen. 192

9. Public Health Law, Art. 12, Section 1303; Conservation Law, Section 410; Code of Criminal Procedures, Section 56(35); Penal Law, Section 1759

Existing remedies and rights of action, including enforcement procedures by

local officials, to suppress or abate water pollution were not displaced by the enactment of Public Health Law, Article 12. That statute, effective January 1, 1962, created additional remedies which are available when the State Department of Health determines that violations of Article 12 warrants State action.

1964 Op. Atty. Gen. 124

2. Water Rights

a. Doctrine

The common law doctrine of riparian rights has been the basic New York water law from the earliest times. Under the doctrine of riparian rights neither sovereign nor subject can acquire anything more than a mere usufructuary right in flowing water (Niagara Mohawk Power Corp. v. Federal Power Commission, 202 F. 2d 190 (U. S. Ct. of App., Dist. of Columbia, 1952)).

Riparian rights link water use to ownership of the land along or through which the water flows. Holders of riparian rights can use the water associated with their land subject only to "reasonable" consideration of the landowners downstream. Riparian rights may be exercised or not, as the landowner prefers. Either way, they remain in force always subject to the "reasonable" needs of other riparian owners and are freely transferable with the land ownership.

> "The states following the riparian doctrine are divided into two groups. One group follows the so-called natural flow theory, another group follows the so-called reasonable use theory. The group still following the natural flow theory has become definitely a minority group. The group following the reasonable use theory has become definitely the majority group; * * *."[13]

One cannot be certain which group New York is in "because the judicial expressions are conflicting".[14]

The natural flow version of the riparian rights doctrine

> "forbids a riparian owner, except when making a domestic or natural use, to alter materially the natural condition of a watercourse or lake, even though such alteration will cause no immediate harm. * * * The reasonable use version of the riparian doctrine * * * permits a material alteration of the natural condition of a watercourse or lake, even for artificial or non-domestic uses, and even though the alteration causes harm to a riparian owner, provided the alteration is

13. Farnham, William F. Report of the Temporary State Commission on Water Resources Planning, 1965, Leg. Doc. (1965) No. 27, p. 132.

14. Ibid.

reasonable in view of all the circumstances; * * *."[15]

The general rules governing the rights of riparian owners are set forth in the leading case of Strobel v. The Kerr Salt Company, 164 N.Y. 303, 58 N.E. 142 (1900) (pp. 320-321):

> "A riparian owner is entitled to a reasonable use of the water flowing by his premises in a natural stream, as an incident to his ownership of the soil, and to have it transmitted to him without sensible alteration in quality or unreasonable diminution in quantity. While he does not own the running water, he has the right to a reasonable use of it as it passes by his land. As all other owners upon the same stream have the same right, the right of no one is absolute, but is qualified by the right of the others to have the stream substantially preserved in its natural size, flow and purity, and to protection against material diversion or pollution. This is the common right of all, which must not be interfered with by any. * * * Consumption by watering cattle, temporary detention by dams in order to run machinery, irrigation when not out of proportion to the size of the stream, and some other familiar uses, although in fact a diversion of the water involving some loss, are not regarded as an unlawful diversion, but are allowed as a necessary incident to the use in order to effect the highest average benefit to all the riparian owners. As the enjoyment of each must be according to his opportunity and the upper owner has the first chance, the lower owners must submit to such loss as is caused by reasonable use. Surrounding circumstances, such as the size and velocity of the stream, the usage of the country, the extent of the injury, convenience in doing business and the indispensable public necessity of cities and villages for drainage, are also taken into consideration, so that a use which, under certain circumstances, is held reasonable, under different circumstances would be held unreasonable."

There is a conflict of authority in the New York judicial decisions as to whether one can enjoin an interference with the natural condition of watercourses and lakes which, although presently harmless, might become harmful in the future. The weight of opinion holds that a riparian owner has the right to enjoin a substantial alteration of the stream flow, even though harmless, in conformity with the doctrine that stream

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15. Cornell Water Resources Center Report, Appendix "B", pp. 226-227 of the Report of the Temporary State Commission on Water Resources Planning, 1965. See note 13, ante.

water must be allowed to continue to flow as it has been accustomed to flow.[16]

Among the New York cases expressly recognizing the prevalence of this doctrine are: Clinton v. Myers, 46 N. Y. 511, 7 Am. Rep. 373 (1871); Bullard v. Saratoga Victory Mfg. Co., 77 N. Y. 525 (1879); Strobel v. Kerr Salt Co., 164 N. Y. 303, 58 N. E. 142 (1900); Smith v. City of Rochester, 38 Hun 612 (1886), affd. w.o. 104 N.Y. 674 (1887); Neal v. City of Rochester, 156 N. Y. 213, 50 N. E. 803 (1898); Townsend v. Bell, 62 Hun 306 (1891); N. Y. Rubber Co. v. Rothery, 132 N. Y. 293, 30 N. Y. 841 (1892); Gilzinger v. Saugerties Water Co., 66 Hun 173 (1892), affd. on opin. below, 142 N. Y. 633, 37 N. E. 566 (1894); Amsterdam Knitting Co. v. Dean, 162 N. Y. 278, 6 N. E. 757 (1900); Mann v. Willey, 51 App. Div. 169, 64 N. Y. Supp. 589 (1900), affd. w.o. 168 N. Y. 644, 61 N. E. 1131 (1901).[17]

But see Knauth v. Erie Railroad Company, 219 App. Div. 83, 219 N. Y. Supp. 206 (1926), which holds that an interference with the natural condition of a watercourse is not actionable until it causes harm.[18]

In several statutes there are provisions expressly preserving riparian rights — even stating that nothing contained in the statute shall be so construed as to impair riparian rights. (See Conservation Law, Section 441, subd. (1), par. (f), Section 502, subd. (1); Public Health Law, Sections 1167, 1260, 1261.)

b. Surface Water

The New York case law

> "with respect to the use of surface water seems to be in accord with the generally prevailing view that any landowner is free to retain and consume for any useful purpose all of the surface water which forms on his land, regardless of harm to others and without obligation to confine his retention and consumption to amounts which are reasonable in view of the needs of others."[19]

In a word, judicial expressions "indicate you can do what you like with surface waters."[20]

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16. Id. at p. 208.

17. For an excellent discussion of these cases see Cornell Water Resources Center Report, note 15 ante, at pp. 208-212.

18. Id. at p. 215.

19. See note 15, ante, at p. 247.

20. See note 13, ante, at p. 135.

As to diffused surface water (rains, floods, snow) which has become separate from a stream, the rule is the landowner can capture all the diffused surface water which he wants and make such use of it as he desires. However, if the waters involved constitute part of a stream, a riparian owner would only have his riparian rights including the privilege of reasonable use and the right that this privilege should be enjoyed without unreasonable interference.[21]

c. Ground Water

The riparian doctrine as outlined above in "Surface Water" applies to subterranean streams.

With respect to the use of percolating water, a landowner may take and use all such water as he can get by reliance on natural forces or by pumping, even though he causes damages to his neighbor, provided he uses it on his own land, and provided the water is actually percolating water and not drawn from a natural watercourse, above or below ground.

The New York courts have held that interception of percolating water which would feed a stream unless otherwise diverted, can be unreasonable and unlawful. Smith v. City of Brooklyn, 160 N. Y. 357, 54 N. E. 787, 45 LRA 664 (1899); Stevens v. Spring Valley Water Works, 42 Misc. 2d 86 (Sup. Ct., App. Term, 2nd Dept., 1964), 247 N. Y. S. 2d 503.[22]

d. Access to Lakes and Streams

In several statutes there are provisions expressly granting the right of access to administrative agencies or officials to enable them to perform their statutory duties, in language such as this (Conservation Law, Section 422):

> "The (Water Resources) Commission or its duly appointed agents shall have the right to enter at all times in or upon any property, public or private, for the purpose of inspecting or investigating conditions relating to matters within the jurisdiction of the Commission." (See also Conservation Law, Sections 175, 437, subd. (14), 584, subd. (2); Matter of Suffolk County Water Authority v. Water Power and Control Commission, 12 A. D. 2d 198, 202 (3rd Dept., 1961), 209 N. Y. S. 2d 978).

21. Cornell Water Resources Center Report at pp. 243-245.

22. Id. at p. 248.

A right to enter is expressly reserved to the Commissioner of Health in Article 12 of the Public Health Law, Section 1210, subd. (5) in regard to water pollution abatement and also in Article 11 of the Public Health Law, Section 1101 in regard to public water supplies.

e. Diversions Between Basins

The Conservation Law generally regulates and controls diversions between basins.

Article V, Part VI of the Conservation Law requires the prior approval of the Water Resources Commission to any diversions, between two watersheds located wholly within the State, for public water supply purposes.

Conservation Law, Section 452, subd. (1) prohibits the diversion of the water supply of New York State into any other state except where the written consent of the Water Resources Commission has been obtained. The statute states:

> "No person or public corporation shall transport or carry through pipes, conduits, ditches or canals the waters of any fresh water lake, pond, brook, river, stream, or creek in this state or any well, subsurface or percolating waters of this state into any other state for use therein * * *."

Interstate water compacts contain provisions which regulate and control any diversion or furnishing of water authorized by or made pursuant to the compact.

f. Eminent Domain

Article I, Section 7, subd. (a) of the New York State Constitution provides that "Private property shall not be taken for public use without just compensation." (See also, Article IX, Section 1, subd. (e).)

In New York State a riparian right is a property right. United Paper Board Co. v. Iroquois Pulp & Paper Co., 226 N. Y. 38, 123 N. E. 200 (1919); Matter of Van Etten v. City of New York, 226 N. Y. 483, 125 N. E. 201 (1919).[23]

Waters cannot be diverted for public consumption without payment of damages to riparian owners. Smith v. City of Rochester, 92 N.Y. 463 (1883); see also, Water Power and Control Commission v. Niagara Falls Power Co., 262 App. Div. 460 (4th Dept., 1941); affd. 289 N.Y. 353, 45 N. E. 2d 907 (1942).

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23. Id. at p. 228.

In Article V of the Conservation Law there are several provisions expressly granting the right of eminent domain to the Water Resources Commission. (Conservation Law, Section 423; see also Sections 512, 514, and 584.)

TABLE I

NEW YORK CONSTITUTIONAL

AND

STATUTORY REFERENCES ON WATER

Statute	Subject
Constitution, Article I, Section 7(a)	Eminent Domain
Constitution, Article I, Section 7(d)	Drainage of agricultural lands
Constitution, Article VIII, Section 2-a, 5(E)	Local Finance — Indebtedness authorized for water supply, sewage disposal and drainage systems; exclusion from debt limitation
Constitution, Article XIV, Section 1	Forest Preserve Lands — to be forever kept wild
Constitution, Article XIV, Section 2	Reservoirs — Forest Preserve Lands
Constitution, Article XV; Canal Law, Section 40; Public Works Law, Section 8	Canals
Constitution, Article XVII, Section 3	Public Health
Civil Practice Law and Rules, Section 506(b) (2)	Special proceedings against Water Resources Board — where commenced
Conservation Law, Article V	Water Resources Law — Water Resources Commission
Conservation Law, Article 6	Division of Water Resources (in Conservation Department)
County Law, Article 5-A, Sections 250-276	County Water, Sewer Drainage and Refuse Districts
County Law, Article 5-D, Sections 299-1 - 299-x	County Small Watershed Protection Districts
General City Law, Section 20	City water supply and sewage systems and flood control projects
General Municipal Law, Section 119-o	Joint municipal water, or drainage projects
General Municipal Law, Section 119-p	Projects relating to the use of atmospheric water resources

Statute	Subject
General Municipal Law, Section 120-u	Mutual aid for water services
General Municipal Law, Section 462	Interlocal agreements authorized for supply of water, sewage disposal and storm drainage
Local Finance Law, Section 11.00	Time limitation on which indebtedness may be contracted for water supply systems, river regulating reservoirs, waterway improvement and drainage, sewer systems, dredging and construction to make streams navigable and for flood protection
Local Finance Law, Section 15	Indebtedness relative to municipal cooperative activities — joint water, sewage or drainage projects
Local Finance Law, Sections 34.00, 36.00	Bond resolution to provide sewage treatment facilities not subject to referendum
Local Finance Law, Section 136.00	Statement of total debt by municipality — water and sewage indebtedness may be deducted
Navigation Law, Article 11, Sections 140-144	Improvement and preservation of waterways — harbors of refuge and marine facilities
New York State Sanitary Code, (10 N.Y.C.R.R., Chapter 1)	New York State Sanitary Code
Public Authorities Law, Article 5, Title 1, Sections 1000-1016	Power Authority of the State of New York
Public Health Law, Article 11	Public water supplies; sewerage and sewage control
Public Health Law, Article 12	Water Pollution Control Law
Public Lands Law, Article 6, Sections 75-78	Grants of lands under water
Public Service Law, Article 4-B, Sections 89-a to 89-o	Regulation of private water-works corporation
Real Property Tax Law, Section 477	Tax exemption for industrial waste treatment facilities

Statute	Subject
Real Property Tax Law, Section 490	Exemption from special ad valorem levies and special assessments — water supply, sewer systems, waterways and drainage improvements
Real Property Tax Law, Section 566	Dam and reservoirs — assessment procedure
Soil and Water Conservation Districts Law	Soil and water conservation districts
State Finance Law, Section 61(18)	Probable life of sewage treatment facilities
State Finance Law, Section 97-h	Pure waters debt fund
State Law, Article 3, Sections 20-38	State lands ceded to the United States
Tax Law, Sections 208, 612, 683, 706, 1083	Deduction of certain expenditures for industrial waste treatment facilities
Town Law, Article 12, Sections 190-208-a	Town water supply, sewer and drainage districts and special improvements
Transportation Corporation Law, Article 10, Sections 115-124	Sewage disposal corporations
Village Law, Sections 89, 220-239	Village sewage, water supply systems and water works
Laws of 1936, Chapter 862; McKinney's 1965 Unconsolidated Laws, Title 4, Chapter 1, Sections 1301-1310; Public Works Law, Section 8	Flood control projects
Laws of 1927, Chapter 654; McKinney's 1965 Unconsolidated Laws, Title 16, Chapter 19, Sections 6121-6143	Municipal joint water works systems
Laws of 1953, Chapter 882; McKinney's 1965 Unconsolidated Laws, Title 29	Waterfront Employment Regulation
Laws of 1921, Chapter 154; McKinney's 1965 Unconsolidated Laws, Title 17, Chapter 1, Section 6401 et seq.	Port of New York Authority
Conservation Law, Article VII, Title I, Sections 801-812; Laws of 1952, Chapter 701; McKinney's 1965 Unconsolidated Laws, Title 4, Chapter 8, Sections 1581-1584	Interstate water compacts: Delaware River Basin Compact

Statute	Subject
Conservation Law, Article VII, Title II, Sections 815-822	Great Lakes Basin Compact
Conservation Law, Article IV, Section 325	Atlantic States Marine Fisheries Compact
Public Health Law, Article 11-A, Sections 1180-1186	New England Interstate Water Pollution Control Compact
Public Health Law, Article 11-B, Sections 1190-1198	Ohio River Valley Water Sanitation Compact
Public Health Law, Article 12-B, Sections 1299-1299-1	Tri-State Compact and Interstate Sanitation Commission

APPENDIX III

POLITICAL SUBDIVISIONS

The structure of local government in New York is remarkable for the multiplicity of types of political subdivisions employed. The State is divided into 62 counties, and the counties are in turn divided into varying numbers of cities and towns. Town boundaries are contiguous so that every portion of the State outside of the corporate limits of a city is included in a town. Two types of municipal corporations exist in New York State — the village and the city.

The 62 counties of New York State presently contain 932 towns, 554 villages and 62 cities. The revenues to support these governments come, in the main, from taxes on property and districts, State aid, fees, licenses and fines. Local sales and use taxes are imposed by a few counties and cities for additional revenue.

COUNTIES

A Board of Supervisors is the usual governing and legislative body in a county, with the exception of the five counties (boroughs) that comprise the City of New York. New York City is governed by a City Council made up of representatives from each borough.

A County Board of Supervisors consists of at least one Supervisor from each town and from any cities that may lie within that county. The presiding head of a Board of Supervisors is the Chairman, who is elected by the Board members. Several counties have an elected county executive who serves as chief administrative officer and shares policy-making powers with the Board through the power of veto.

TOWNS

A town is governed by an elected Town Board, presided over by the elected Supervisor, who also acts as the town executive and as the town's representative on the County Board of Supervisors. The other town officials vary considerably from town to town, and are usually elected, although some are appointed.

Towns are divided into several classes, based upon population and assessed valuation. The larger towns are permitted a more complex governmental structure and have authority to perform more extensive services for their residents.

Towns are responsible for numerous local governmental services, such as road construction and maintenance, but are not geared to provide municipal-type

services to population centers. Such services may be performed by special improvement districts formed for the purpose, or by municipalities.

VILLAGES

A village is incorporated after petition of, and election by, the residents of the community. Villages are created under the Village Law, and all have essentially the same governmental structure and authority. This Law establishes several classes of villages, based on population, and their detailed organization and powers vary from class to class.

Villages, unlike cities, remain a part of the town. Village residents vote in town elections, pay town taxes and receive town services.

The village is governed by an elected Mayor and Board of Trustees, who appoint a number of other officers. Village government may more easily provide municipal services such as water supply, sewage disposal, fire and police protection, street lighting, etc. than town government.

CITIES

Cities, like villages, are municipal corporations, created at the will of the residents of the communities. Unlike a village, each city has its own charter, drafted to meet the specific needs of the area. Thus, the governmental structure and powers of cities vary greatly. Cities are completely divorced from the towns, but each city elects one or more Supervisors to represent the city on the County Board.

One normally thinks of cities as being larger and wealthier than villages. This is not always the case — some cities have fewer than 3,000 inhabitants and some villages approach a population of 40,000.

The governmental structure of cities varies greatly but generally consists of an elected council with either an elected mayor or an appointed city manager. A variety of other officials, mostly appointed, administers the various departments.

Cities have extremely broad powers for local governmental activities. Under the City Home Rule Law, a city may virtually take any measures not in conflict with the State Law or Constitution.

APPENDIX IV

SPECIAL PURPOSE DISTRICTS

SOIL AND WATER CONSERVATION DISTRICTS

If soil erosion and related problems cause sufficient public concern, a County Board of Supervisors can set up a Soil and Water Conservation District. The directors of such a district consist of two members from the Board of Supervisors, two practical farmers and a lay member representing non-agricultural interests.

These districts are empowered to make necessary surveys and investigations and carry out such preventive and control measures as are indicated to reduce damages due to floodwaters, erosion and sedimentation.

The State Soil and Water Conservation Committee (see Chart 16 below) co-

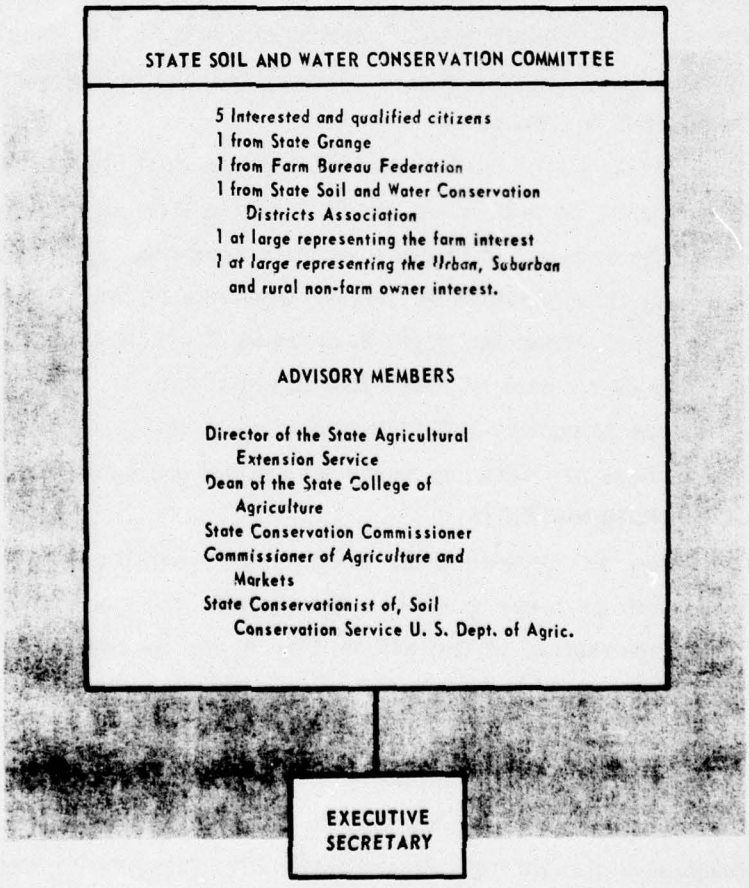

Chart 16

ordinates the work of these districts. The State committee cooperates with the Soil Conservation Service of the U. S. D. A. and allots federal aid funds to the several districts.

COUNTY SMALL WATERSHED PROTECTION DISTRICTS

A County Board of Supervisors may, with the approval of the Water Resources Commission, form a County Small Watershed Protection District for the purpose of constructing appropriate flood prevention measures under the PL 566 program. Federal grants, administered by the Soil Conservation Service, pay the entire construction cost of such facilities attributable to flood prevention. Remaining costs, including all land and right of way costs, are paid by local tax funds. The State reimburses the counties involved 50% of the expenditures for the land, easements and rights-of-way required for construction of the flood prevention facilities.

The functions of a County Small Watershed Protection District may be carried out directly by the County Board of Supervisors without the establishment of a District.

DRAINAGE IMPROVEMENT DISTRICTS

When it is deemed wise to drain certain agricultural land to make it more productive, or for reasons of public health or safety, a Drainage Improvement District may be formed by the owners, or lessees, of the property to be improved.

These persons first petition the Water Resources Commission for the right to initiate such a project. When the right to proceed is granted, a public corporation is formed by the landowners, each of whom has an equal vote.

These districts construct and maintain such drainage projects as seem desirable. The costs of these projects are assessed against the lands benefited.

OTHER SPECIAL PURPOSE DISTRICTS

A District can be created also to provide for water supply, fire protection, sewerage, recreation or other purposes that benefit the public. The District can be initiated by any organization in the affected area and its cost is underwritten by the District itself.

The administration of county districts is the same as for small watersheds (above). Town Boards normally administer the affairs of a district within a town.

The Conservation Law provides for the formation of river regulating districts and one such agency, the Hudson River-Black River Regulating District (see p. 20) is in operation. The same law permits the establishment of districts for river improvement, drainage improvement and combined river regulation and river improvement.

PENNSYLVANIA

STATE LAWS, POLICIES AND PROGRAMS
pertaining to
WATER AND RELATED LAND RESOURCES

AUGUST 1966

COMMONWEALTH OF PENNSYLVANIA
DEPARTMENT OF FORESTS AND WATERS

STATE LAWS, POLICIES, AND PROGRAMS PERTAINING TO WATER AND RELATED LAND RESOURCES

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COMMONWEALTH OF PENNSYLVANIA

STATE LAWS, POLICIES, AND PROGRAMS

pertaining to

WATER AND RELATED LAND RESOURCES

HISTORY

CONSERVATION AND UTILIZATION of the NATURAL RESOURCES OF PENNSYLVANIA

The history of conservation in Pennsylvania began on July 11, 1681, when William Penn, Proprietary and Governor of the Province and a man of vision, listed "certain conditions or concessions" to be agreed upon between himself and "those who are adventurers and purchasers in the same Province".

Penn is generally conceded to be the "New World's" first conservationist since the eighteenth of his listed conditions recognized the importance and potential of "Penn's Woods" by stating "that in clearing the ground care be taken to leave one acre of trees for every five acres cleared, especially to preserve oak and mulberries for silk and shipping".

Further, in 1690, he proposed another settlement or city "upon the river Susquehannagh" and pointed out a water route to connect Philadelphia and the Susquehanna via the Schuylkill River and Tulpehocken Creek to Swatara Creek, a tributary of the Susquehanna.

This route, the first to be surveyed in America (1762) was to become the route of the Union Canal, which was placed under construction in 1792 and finally completed in 1828.

In view of the fact that the early colonists were almost totally dependent on the bountiful natural resources of the Northern Continent to meet their daily needs and, indeed, for their very survival, it is not surprising that Pennsylvania's founder was interested in preserving her forest resources and in utilizing her streams for commerce. A law enacted in 1721 protected deer from January 1 to July 1, imposing a fine of 20 shillings for the violation of this act.

While some of the North American colonies were settled by our forefathers in search of religious and political freedom, the motive behind the settlement of others was pure speculation - the colonists and their

sponsors hoped to find either gold, jewels, and spices or a short route to the riches of India.

These hopes soon died, of course, but the colonists did find many other sources of wealth, and consequently, the bulk of their trade and exports were the products of the New World's forests, fields, and streams.

One of these new sources of wealth was furs.

Not only was the fur trade historically significant, but the furs had great economic value - beaver pelts were once a standard form of currency in the new colonies.

With the rapid growth of an extensive market for furs in Europe, the fur trade grew to such proportions that it became a major factor in the growth and expansion of the colonies.

Between 1756 and 1763, a number of European nations were pitted against each other in the Seven Years' War, with France and England on opposite sides. The American phase of the war, the French and Indian War, eventually threw the balance of power in the New World to England and her colonies.

The Pennsylvania colony was deeply involved in the war, which was precipitated, at least in part, by the desire of both England and France to gain control of the fur trade and the trade routes.

The trappers and fur traders, then, in the process of exploiting the Commonwealth's wildlife resources, played a major role in opening up the wilderness and in leading civilization across the mountains into western Pennsylvania and the Ohio area.

Because commerce on a large scale was limited by the high cost of transporting goods over poor roads and trails by packtrain and wagon, Pennsylvania turned to water transportation and began to construct a canal system, designed to connect her great rivers and cross the Appalachian barrier.

A little over a century after Penn's farsighted dream, the Commonwealth's first artificial waterway, the Conewango Canal, was completed (1797) along the west bank of the lower Susquehanna.

The Pennsylvania or "Main Line" Canal, finally connecting Pittsburgh to the eastern seaboard, was completed in 1834, utilizing the 36-mile Portage Railroad and its unique inclined planes to transport canal boats, freight, and passengers over the Allegheny Mountains between Hollidaysburg and Johnstown.

The boom days of Pennsylvania's extensive canal system, much of which was constructed and operated by the Commonwealth, lasted just a

little over a quarter of a century. East of the mountains, it was possible to travel by canal and slack water from the Delaware Bay north into the coal regions and westward to the Susquehanna. Virtually the entire shallow Susquehanna was paralleled by canals from New York State to the Chesapeake Bay, and, in the west, links were established between Pittsburgh, Ohio, Meadville, and Erie.

By the middle of the 1850's, the railroads had become strong competitors and shortly thereafter, most of the canals of western Pennsylvania ceased operation. Because of heavy coal traffic - the canals played a major role in the development of the anthracite industry - a few of the canals in the eastern part of the State managed to continue operating into the 20th century, with the last ceasing operations in 1931.

Despite their relatively brief life, the canals did provide adequate and economical transportation of goods and people where none before existed. Thriving communities sprang up along their route, and they were instrumental in opening up the territory west of the mountains in the Ohio Valley.

Fire was recognized as the main enemy of the forest as early as 1682. In that year, the General Assembly passed an act establishing responsibility for damage to woods by fire and, after the turn of the century, additional legislation was enacted to control forest fire damage.

While these laws were, in fact, conservation measures, the actual motive which led to their passage was the protection of the already growing commerce in wood products with England and the other colonies.

In 1860, Pennsylvania was the largest producer of timber in the United States. Loggers, ignorant of important relationships between forests and water, soil and wildlife, cut the woodlands heavily, floated the lumber downstream, and then moved on to other virgin timber. The young, exposed growth left behind was highly inflammable, and uncontrolled forest fires raged across the State.

By the end of the 1860's, the State was in serious trouble. Hillsides, stripped of their trees, eroded; tons of rich topsoil were washed into our rivers and down to the sea. Without the spongy forest floor to hold it, water ran off in muddy torrents from the State's watersheds, killing families, washing away homes, and destroying industry. Some forms of wildlife became extinct in Pennsylvania, or nearly so.

Pollution of our streams by communities and by industry killed fish life and made precious water unfit for use.

The small groups of Pennsylvanians began speaking out, protesting the tragic waste. They pointed out that the State would die economically if abusive resource practices were not stopped.

It was not until 1856, however, when $12,000 was bequeathed for the promotion of silviculture in the United States from the estate of Andre Michaux, a renowned French botanist, that true conservation began to come into its own. The bequest had been made to the Philadelphia Philosophical Society, and that organization, in 1877, chose Dr. Joseph T. Rothrock as the Michaux lecturer on silviculture.

Dr. Rothrock, born in McVeytown, Mifflin County, in 1839, had wide experience in the fields of botany, medicine, and education, and it was largely through his continuing efforts that the Pennsylvania Forestry Association was organized in Philadelphia in 1886. He was elected as the first president of the association and campaigned vigorously between 1877 and 1895 for a program of organized forestry in the Commonwealth.

Success finally came in 1895, when a Bureau of Forestry was established within the newly-formed Department of Agriculture, and Dr. Rothrock became the State's first Forest Commissioner. Because of his untiring, lifetime effort to restore "Penn's Woods", Dr. Rothrock has been called "The Father of Pennsylvania Forestry".

Laws relating to baiting, snaring, and trapping of game birds and animals were enacted in 1869. Subsequent laws relating to the wildlife of Pennsylvania led to the 1895 act creating a Board of Game Commissioners, the forerunner of the present Game Commission and, in the fall of the following year, the first appointment was made to the Board. The first Game Refuge Law was passed in 1905 and in 1919, the law authorizing the purchase of State Game Lands was enacted. The first State Game Lands were purchased in 1920.

The Pennsylvania Fish Commission, on the other hand, has had a longer history, having evolved from a one-man board which was created in 1866 primarily to re-establish shad runs in the Schuylkill and Susquehanna Rivers which were blocked by dams. The first state fish hatchery came into being seven years later (1873) at Marietta in Lancaster County, and the first fish raised were shad.

The first State park, preserving the area where General George Washington's troops spent the winter of 1777-78, was established at Valley Forge, northwest of Philadelphia, in 1893.

In 1898, the first State forest lands were purchased for the protection of the watersheds of the State's major rivers; to restore the Commonwealth's timber supply, and to provide recreation for her citizens.

An act, passed in 1901, changed the Division of Forestry to a separate State Department of Forestry, and in the same year, the State's first technically trained forester was appointed by the new department and located at Mont Alto. He developed and organized the basic fire protection system as it now operates in Pennsylvania.

The Nation's second academy for training foresters was established at Mont Alto in Franklin County in 1903, and became the nucleus for a strong Forest Service in Pennsylvania. The Commonwealth is the only state to ever train foresters solely for State service.

Because of the early interest in utilizing the Commonwealth's streams for commerce, the General Assembly from 1771 to 1881 passed a series of well over 200 acts declaring certain rivers, creeks, and streams or parts thereof, to be public streams or public highways for the purpose of navigation.

Another early act concerned with the utilization of the Commonwealth's streams was the "Mill Dam Act" passed by the General Assembly in 1803 and authorizing any person or persons owning land adjoining navigable streams of water, declared public highways, to erect dams upon such streams for mills and other water works, subject to certain stated restrictions.

In 1907, the Legislature enacted a law governing all obstructions in the navigable waters of the Commonwealth. This act was succeeded by the Act of June 25, 1913, PL 555, which extended regulations and controls over obstructions and encroachments to all waters of the Commonwealth, nonnavigable as well as navigable.

The Water Supply Commission of Pennsylvania was created in 1905 and charged with the duties of procuring all data and facts necessary to thoroughly evaluate the water supply situation of the state and to adopt ways and means of utilizing, conserving, purifying, and distributing such water supply to the various communities of the Commonwealth in an equitable manner. In addition, the Commission was charged with the duty of recommending future legislation which might be required with respect to the waters of the Commonwealth.

Under the Act of July 25, 1913, PL 1233, the Commission was specifically authorized to make a complete water resources inventory for the Commonwealth. This task was finished a number of years later and included a complete stream inventory (Gazetteer).

Much of this activity in water resources and control over encroachments can be directly traced to a number of dam failures in Pennsylvania, beginning with the failure of the South Fork Dam in 1889 above Johnstown, where over 2,000 lives were lost. Following this, the Oakford Park Dam in western Pennsylvania failed on July 5, 1903, with a loss of 20 lives, as did the Austin Dam which caused a loss of 78 lives in Potter County on September 30, 1911.

Gifford Pinchot, former United States Chief Forester under President Theodore Roosevelt, became Commissioner of Forestry in Pennsylvania in 1920, serving until 1922, when he was elected Governor. Being an ardent conservationist, he was instrumental in expanding and modernizing the

State forestry, park, water, and recreation programs, both as Commissioner of Forestry and Governor. He was succeeded as Commissioner of Forestry by Robert Y. Stuart, who later became Chief of the United States Forest Service.

During Governor Pinchot's first administration, the present Department of Forests and Waters and its administrative arm, the Water and Power Resources Board, were created in 1923. This change combined the water services, formerly under the Water Supply Commission with the forest services of the Department of Forestry.

The Sanitary Water Board of the Department of Health was created in the same year and was given limited powers to administer the sewerage and anti-pollution laws of the Commonwealth.

During the depression years of the 1930's - the "Dust-Bowl Years", when extended drought and poor farming practices combined to make it appear that much of the American Southwest was blowing away - soil conservation first came to Pennsylvania.

In 1935, President Franklin D. Roosevelt proposed a standard soil conservation law to the Governors of the various states. Eventually laws based upon this recommendation were adopted by all of the states. Pennsylvania was among the first states to pass a Soil Conservation Law with such action taking place in 1937. This law has been rewritten in 1945 and then later amended (1963) in an attempt to gear local conservation programs to changing conditions. This legislation established the State Soil and Water Conservation Commission and authorized county government to establish county-wide districts. Soil and water conservation districts are now organized in 64 of the 67 counties of Pennsylvania. Districts assume leadership in developing and carrying out county-wide soil and water conservation programs, with the assistance of State and federal conservation agencies.

During the 1963 session of the General Assembly, two of the most advanced acts controlling strip mining of both bituminous and anthracite coal were passed. Strict enforcement of these two laws will further reduce acid pollution in our streams and assure that, once the coal is removed, the land will be returned as nearly as possible to its original condition.

Pennsylvania, in 1965, amended its Clean Streams Law to completely remove exceptions, previously granted, for certain mine drainage conditions, and place all mine drainage in the same category for regulating and controlling industrial wastes. Special restrictions have been prescribed for mine drainage. No mining permit will be issued if discharges from mining operations will be injurious to the public health, animal, or aquatic life; or to the use of the water for domestic, industrial, consumption, or recreation.

In 1966, an act was passed which provides for the Commonwealth to enter into the Interstate Mining Compact to assure sound mining practices with other states of the United States which are signatories thereto, granting the Governor authority to execute such compact, and to serve as the official representative of the Commonwealth. The act also creates a Mining Practices Advisory Council in the office of the Governor. Two of the purposes of the compact are to advance the protection and restoration of land, water, and other resources affected by mining, and to assist in the reduction or elimination or counteracting of pollution or deterioration of land, water, and air attributable to mining.

The conservation of minerals and the development of conservation practices, designed to restore other natural resources damaged in the process of extracting mineral resources, have become increasingly important to the Commonwealth over the years.

Pennsylvania's conservation program continues to progress and her achievements of the last decade prompted one National conservation organization to say that the Commonwealth is having a "Resource Renaissance".

STATE LAW

The Commonwealth's present Constitution became effective on January 1, 1874 and has been amended many times during the interim.

At the time the Constitution was being considered, Pennsylvania's once-extensive canal system was still handling a sizeable volume of freight in a number of areas. Accordingly, Article XVII (Railroads and Canals) was included, regulating railroad and canal companies as common carriers and declaring railroads and canals to be public highways. Other than this one article, the only direct references to water and related land resources are to be found in Sections 21 and 24 of Article IX (Taxation and Finance), added much later by amendments in 1945 and 1963, respectively.

Section 21 authorizes the Commonwealth to "create debt and issue bonds in the amount of fifty million dollars ($50,000,000) for the construction of public buildings, highways, drainage and sanitary systems, anti-stream pollution and flood control projects, for the purpose of reforestation,....."

Section 24 brought Pennsylvania's PROJECT 70 Program into being by authorizing the Commonwealth "to create debt and issue bonds to the amount of 70 million dollars ($70,000,000) for the acquisition of lands for state parks, reservoirs, and other conservation, recreation and historical preservation purposes, and for participation by the Commonwealth with political subdivisions in the acquisition of lands for parks, reservoirs, and other conservation and recreation and historical preservation purposes,....."

The Commonwealth has, in the past, followed the path of doing first-things-first - dealing with water and related land resource problems as they materialized and the need for action became urgent. While this course of action made the State a leader in the fields of flood control and flood forecasting, forest management, game and fish management, and pollution abatement, it also had the effect of decentralizing activities and fostering the growth of separate bodies of law and policy in accordance with the purpose and field of endeavor of the particular agencies involved.

Regulation of Pennsylvania's water and related land resources and the administration of her many and varied water and conservation programs are, then, guided by statutory law which vests the necessary powers in several different agencies.

For example, the administration of the water management program of the Commonwealth is the responsibility of the Department of Forests and Waters and its administrative board, the Water and Power Resources Board, while administration of the pollution control program is vested in the Pennsylvania Department of Health and its administrative board, the Sanitary Water Board.

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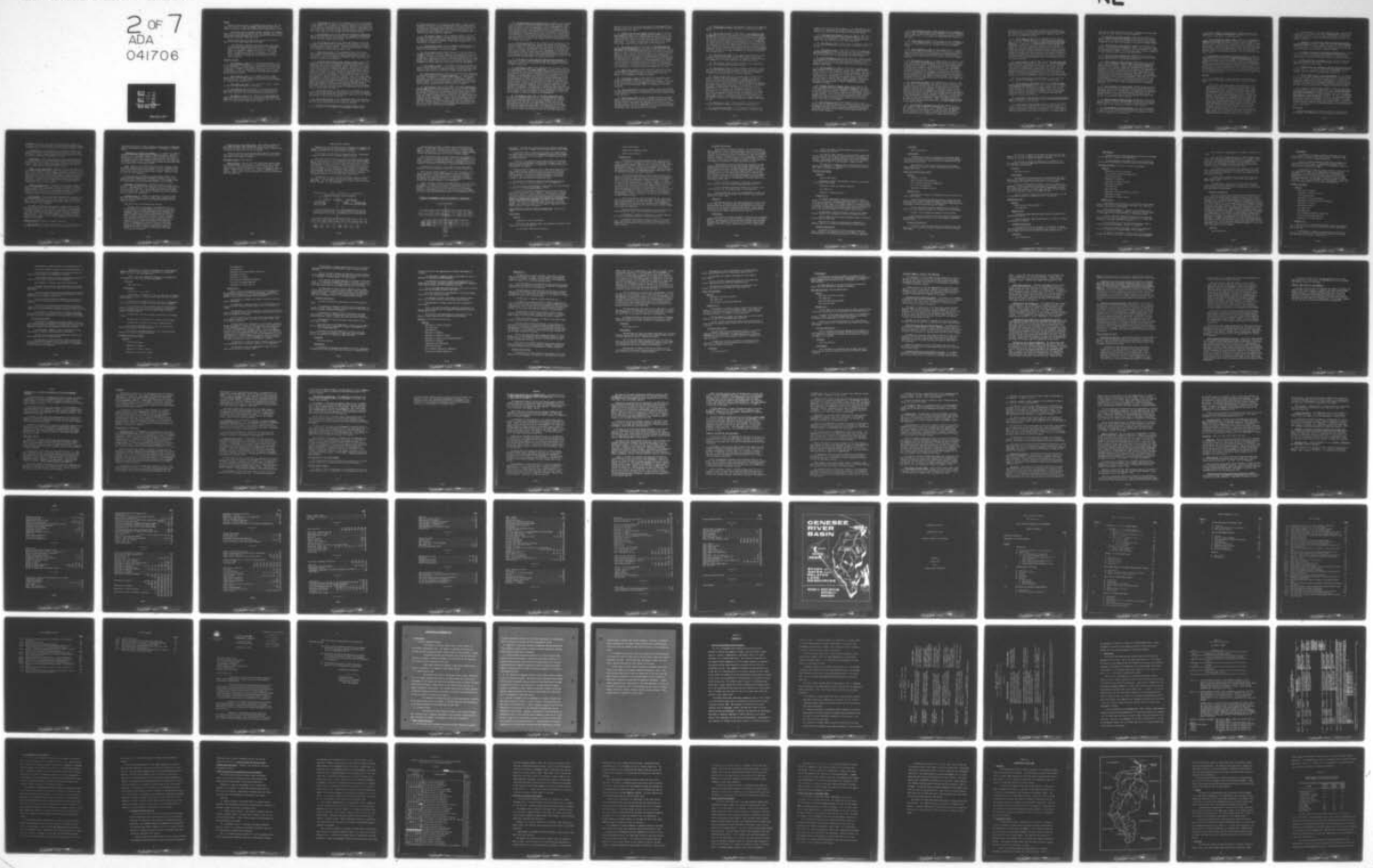


POLICY

Based on various sections of the Administrative Code of 1929, Act #175, PL 177, April 9, 1929, as amended, Pennsylvania's policy with regard to water and related land resources may be summarized as follows:

The forests, waters, and other natural resources of the Commonwealth shall be protected, preserved, developed, managed, and controlled for the public good and benefit and in such manner as to assure that all present and future public needs may be met.

Pennsylvania's water pollution control policy is set forth in Section 3 of its "Clean Streams Law" as follows:

> "The discharge of sewage or industrial waste or any noxious and deleterious substances into the waters of this Commonwealth, which is or may become inimical and injurious to the public health, or to animal or aquatic life, or to the uses of such waters for domestic or industrial consumption, or for recreation, is hereby declared not to be a reasonable or natural use of such waters, to be against public policy and to be a public nuisance."

PRINCIPAL STATUTES

1. Act of March 30, 1866, PL 370, concerned the passage of fish in the Susquehanna River and certain of its tributaries, and provided for the appointment of a commissioner, charged with the task of formulating plans for adequate fish passage facilities and furnishing them to dam owners. He was also empowered to take legal action to assure implementation of the plans. The present Fish Commission eventually evolved from this nucleus.

2. Act of June 25, 1895, PL 273, created the Board of Game Commissioners. This act was repealed by the Administrative Code of 1923 and codified. The Administrative Code of 1923 was later replaced by the Administrative Code of 1929.

3. Act of April 22, 1905, PL 260, 35 PS S 711 et seq., relates to permits for the construction of water works.

4. Act of May 4, 1905, PL 385, Sec 5, 71 PS 1281, requires all applications for charters by water companies to be approved by the Water Supply Commission (now the Water and Power Resources Board).

5. Act of May 11, 1905, PL 451, known as the "Game Refuge Law", established areas for the protection and propagation of wildlife on Commonwealth lands and provided that no hunting was permitted on these areas. This act was later repealed and codified.

6. Act of June 25, 1913, PL 555, as amended, relates to the placement of water obstructions in, along, or across and changing or diminishing the course, current, or cross-section of streams or bodies of water partly within or without the Commonwealth except the tidal waters of the Delaware River and its navigable tributaries and the issuance of permits therefore by the Water Supply Commission (now the Water and Power Resources Board).

7. Act of May 29, 1917, PL 326, known as the "Auxiliary Game Refuge Law", established areas for the protection and propagation of wildlife on private lands and provided that no hunting was permitted on these areas. This act was later repealed and codified.

8. Act of June 20, 1919, PL 533, authorized the Board of Game Commissioners to purchase lands to be known as State Game Lands to be used for game refuges and public hunting. This act was repealed by the Administrative Code of 1923 and codified. The Administrative Code of 1923 was later replaced by the Administrative Code of 1929.

9. Act of July 8, 1919, PL 759, as amended, grants the right and lawful authority to corporations to construct, operate, and maintain tunnels under the beds of navigable streams where necessary to reach their coal supply, subject to the approval of the Water Supply Commission (now the Water and Power Resources Board).

10. The Administrative Code of 1923, The Act of June 7, 1923, PL 498, reorganized the conduct of the executive and administrative work of the Commonwealth by the Executive Department thereof and certain existing and certain new administrative departments, boards, commissions and officers by abolishing, combining, changing the names of, reorganizing, or authorizing the reorganization of, certain administrative departments, boards, commissions, bureaus, divisions, offices, and agencies, and defining the powers and duties of the Governor and other exectuve and administrative officers, and the various agencies. To accomplish this, many prior laws were repealed or repealed in part and codified. Under this reorganization, the Department of Forestry became the Department of Forests and Waters; the Department of Fisheries became the Board of Fish Commissioners, an independent administrative board (as did the Board of Game Commissioners); the Water Supply Commission became the Water and Power Resources Board, a departmental administrative board in the Department of Forests and Waters; and the Sanitary Water Board was created as a departmental administrative board in the Department of Health.

11. Act of June 14, 1923, PL 700 authorizes the condemnation and appropriation of lands, water, and other property by public service companies holding limited power permits and limited water supply permits and limited power permits to public service companies.

12. Act of June 14, 1923, PL 704, as amended, governs the issuance by the Water and Power Resources Board of power and limited water supply permits and limited power permits to public service companies.

13. The Administriative Code of 1929, The Act of April 9, 1929, PL 177, S 2109, 71 PS S 539, empowers the Department of Health to act

as the enforcement agent for the Sanitary Water Board. It also gives the Department the power to issue waterworks permits and stipulates therein the conditions wherein water may be supplied to the public. Article XVIII of the same act, as amended, sets forth the powers and duties of the Department of Forests and Waters, its officers, and departmental administrative and advisory boards and commissions.

14. Act of May 2, 1929, PL 1530, as amended, relates to the construction of a dam by the Water and Power Resources Board as the outlet of Pymatuning Swamp, Crawford County, Pennsylvania, and the establishment of a reservoir to conserve the waters thereof and to regulate the flow in the Shenango and Beaver Rivers.

15. Act of June 12, 1931, PL 528, as amended, authorizes the Water and Power Resources Board to define the locations, fix the regimen, and protect the beds and banks of rivers and streams.

16. Act of August 7, 1936, Special Session, PL 106, as re-enacted and amended March 10, 1937, PL 43 relates to flood control and prescribes the powers and duties of the Water and Power Resources Board in relation to creation of flood control districts, adoption and effectuation of flood control plans, cooperation with public and private agencies and the Federal Government in federal flood control works, and entering into compacts and agreements with other states for flood control works and improvements.

17. Act of June 3, 1937, PL 1225, amends, revises, and changes prior laws concerning game and other wild birds and wild animals, sets up regulations, changes the Board of Game Commissioners to the Pennsylvania Game Commission, and provides for the sale of timber on state game lands.

18. Act of June 22, 1937, PL 1987, 35 PS S 691.1 et seq., as amended, is commonly referred to as the "Clean Streams Law". This act provides for the control and abatement of pollution from all sources. The Sanitary Water Board, an administrative board within the Department of Health, is assigned responsibility for administration of the State water pollution control program. No discharge of sewage or industrial waste may be made and no mine may be opened without prior approval of the Board.

19. Act of July 2, 1937, PL 2724, known as the "Soil Conservation District Law" provided for the conservation of the soil and soil resources of this Commonwealth, and for the control and prevention of soil erosion, and thereby to preserve natural resources, control floods, prevent impairment of dams and reservoirs, assist in maintaining the navigability of rivers and harbors, preserve wildlife, protect the tax base, protect public lands, and protect and promote the health, safety, and general welfare of the people of this Commonwealth. Specific provisions were made for the creation, operation, and administration of the State Soil Conservation Districts. Through the work of the State Board and local district directors, definite soil conservation action programs were developed for the various local districts which were established.

20. The Water Rights Act of June 24, 1939, as amended, PL 842, relates to the acquisition of rights to divert water from rivers, streams, natural lakes, and ponds, or other surface waters within the Commonwealth or partly within and partly without the Commonwealth, vests in the Water and Power Resources Board certain powers and authorities for the conservation, control, and equitable use of the waters within the interests of the people of the Commonwealth; making available for public water supply purposes, water rights heretofore or hereafter acquired but not used. The act provides for issuance of permits by the Water and Power Resources Board to public water supply agencies for the acquisition of water rights in surface waters in order to supply public water.

21. Act of July 25, 1941, PL 505 provides for the cooperation of the Commonwealth and certain political subdivisions thereof with the United States in respect to flood control projects and authorizes the Secretary of Highways on behalf of the Commonwealth and authorities of the various counties, cities, boroughs, and townships, with the approval of the Water and Power Resources Board, to enter into certain agreements with and to grant and convey to the United States certain rights and easements in and relative to the highways, streets, roads, and bridges thereof and lands bordering the same over which such governmental units may have control.

22. Act of April 2, 1945, Ohio River Valley Sanitation Compact, entered into by Illinois, Indiana, Kentucky, New York, Ohio, Pennsylvania, Tennessee, and West Virginia, regarding control and abatement of pollution in waters of said basin.

23. Act of May 8, 1945, PL 435, amended the Act of June 22, 1937, PL 1987, commonly known as the "Clean Streams Law", by changing the definitions of "establishment" and "industrial waste"; by changing and adding penalties for violations and requiring certain prosecutions to be instituted or approved by the Attorney General; by prohibiting the discharge of silt into the waters of the Commonwealth and regulating the discharge of acid mine drainage into waters thereof; authorizing the Sanitary Water Board to establish standards of purity and to determine the time for compliance with the provisions of the act in certain cases; and requiring the board's approval of plans of drainage and disposal of industrial waste and acid mine drainage before opening, reopening, or continuing the operation of coal mines and the changing of approved plans by authorizing the acquisition, by purchase or condemnation, or otherwise, by the Sanitary Water Board of easements or rights of way, and the acquisition or construction of pipes, conduits, drains, or tunnels and pumps, and pumping equipment; and providing for the payment of the costs thereof by the Commonwealth.

24. Act of May 15, 1945, known as the "Soil Conservation Law", provides for a program relating to soil conservation and soil erosion, and land use practices contributing to soil wastage and soil erosion; providing for the organization of the various counties into soil and water conservation districts; the appointment of their officers and employees; and prescribing their powers and duties; creating the State Soil and Water Conservation Commission in the Department of Agriculture and fixing its powers and duties relative to the enforcement of this act; providing financial assistance to such soil and water conservation

districts; and authorizing county commissioners to make appropriations thereto; providing for disposition and operation of existing districts; and repealing existing laws.

25. Potomac River Pollution Compact of May 29, 1945, PL 1134, as amended April 28, 1961, PL 113, provides for the creation of an interstate commission, consisting of members appointed by the State of West Virginia, Maryland, Virginia, and the District of Columbia and by the United States to be known as the Interstate Commission on the Potomac River Basin. Its purpose is to abate and control pollution of interstate streams covering the drainage basin of the Potomac River.

26. Act of May 31, 1945, PL 1198, known as "The Bituminous Coal Open Pit Mining Conservation Act", provides for the conservation and improvement of land affected in connection with the mining of bituminous coal by the open pit mining method; regulates such mining, and provides penalties. NOTE: Section 1 of the act states that "This act shall be deemed to be an exercise of the police powers of the Commonwealth for the general welfare of the people of the Commonwealth, by providing for the conservation and improvement of areas of land affected in the mining of bituminous coal by the open pit or stripping method, to aid thereby in the protection of birds and wildlife; to enhance the value of such land for taxation; to decrease soil erosion; to aid in the prevention of the pollution of rivers and streams, to prevent combustion of unmined coal, and generally to improve the use and enjoyment of said lands".

27. Act of June 1, 1945, PL 1242, Article IV, Section 418, gives the Department of Highways authority to enter streams under its structures to change channels to protect its structures with the prior approval of the Department of Forests and Waters.

28. Act of June 1, 1945, PL 1242, Article VI, Section 601, authorizes the Department of Highways to construct and maintain roads, bridges, and viaducts within or on any State forest lands;.....or within or on any lands owned by the Commonwealth or under the direct control of any administrative department, board, or commission of the State government.

29. Act of June 4, 1945, PL 1383, as amended, authorizes the Water and Power Resources Board to correct existing and prevent future silting of the Schuykill River and its tributaries by wastes from anthracite coal mining operations.

30. Act of June 5, 1947, PL 422, as amended authorizes the Department of Forests and Waters to provide for stream clearance and stream channel rectification, to construct and maintain dams, reservoirs, lakes, and other works of improvement for impounding flood waters, and conserving the water supply of the Commonwealth and for creating additional recreational areas, to acquire lands for such purposes, and to construct and maintain flood forecasting and warning systems.

31. Act of June 12, 1947, PL 584, creates a Flood Control Commission within the Department of Forests and Waters as a department advisory board.

32. Act of June 27, 1947, PL 1095, known as "The Anthracite Strip Mining Law", provides for the regulation of mining of anthracite coal by open pit or strip mining method and for the conservation and improvement of lands affected directly or indirectly by such mining; regulates the licensure of anthracite strip mining operators, pay a license fee and secure a permit to engage in strip mining and file a bond condition for compliance with the act; requires backfilling of stripping pits and levelling and planting lands affected to prevent erosion and the pollution of waters and to protect public health, safety, and welfare, confers powers and imposes duties upon the Department of Mines and the Department of Forests and Waters; provides for appeals, and imposes penalties and makes appropriations.

33. Act of April 25, 1949, PL 729, amends the Administrative Code of 1929, eliminating the Board of Fish Commissioners; creating and extending the provisions of the Code to its successor, the Pennsylvania Fish Commission, and further prescribes its powers and duties.

34. Act of May 18, 1949, PL 1450, authorizes various departments to enter into contracts with state authorities.

35. Act of May 20, 1949, PL 1608, as amended, establishes a State Planning Code, empowering the State Planning Board to conduct research and prepare plans for the proper economic and physical development of the State and the conservation of its natural resources.

36. Act of June 30, 1955, PL 216, concurs with the State of New Jersey in revoking the first paragraph of the Compact between the State of New Jersey and the Commonwealth of Pennsylvania, dated April 26, 1783 and ratified by the act approved September 20, 1783, (2 Smith's Laws 77), entitled "An act to ratify and confirm an agreement made between commissioners appointed by the legislature of the State of New Jersey, and commissioners appointed by the legislature of the Commonwealth of Pennsylvania, for the purpose of settling the jurisdiction of the river Delaware and islands with the same." This act and Chapter 443 of the Public Laws of 1953 of the State of New Jersey constituted an agreement (compact) between the Commonwealth and the State of New Jersey for the purpose of constructing a storage dam on the Delaware River at or near Wallpack Bend, or a diversion dam at or near Yardley or Brookville, or both storage dam or reservoir and diversion dam.

37. Act of July 7, 1955, PL 258, provides for anthracite mine drainage, contingent on federal aid and makes an appropriation.

38. Act of March 14, 1956, PL 1271, provides for cooperation by the Commonwealth of Pennsylvania in conjunction with the State of New

Jersey, with the United States of America in the improvement and maintenance of the Delaware River between Allegheny Avenue, Philadelphia, Pennsylvania, and Trenton Marine Terminal, Trenton, New Jersey.

39. Great Lakes Basin Compact of March 22, 1956, PL 1333 (1955), authorizes a compact between Illinois, Indiana, Michigan, New York, Minnesota, Ohio, Pennsylvania, and Wisconsin for comprehensive development, use, and conservation of the Great Lakes Basin.

40. Act of May 24, 1956, PL 1736, raises the maximum purchase price per acre that may be paid for State game lands from $30.00 to $100.00 per acre.

41. Act of May 29, 1956, PL 1840 (1955), known as the Water Well Drillers License Act, defines and provides for the licensing of water well drillers, prevention of pollution of underground waters; confers powers and imposes duties on the Department of Internal Affairs.

42. Act of September 9, 1959, PL 848, authorizes a compact between the Commonwealth of Pennsylvania and the State of Delaware for the construction of a series of multi-purpose dams and reservoirs on the Brandywine Creek and its tributaries and authorizes a diversion for the Borough of West Chester.

43. Act of December 15, 1959, PL 1779, known as The Fish Law of 1959, repealed "The Fish Law of 1925" (Act of May 2, 1925, PL 448). The act relates to fish; and amends, revises, consolidates, and changes the law relating to fish in the inland waters and boundary lakes and boundary rivers of the Commonwealth. It provides for fishing regulations applying to inland waters and boundary rivers; seine and artificial propagation licenses; dams, fishways, barracks, obstructions; pollution; sale of fish; and fishing and complementary licenses. It also sets forth general powers of the Fish Commission, including enforcement procedures.

44. Delaware River Basin Compact, Act of July 7, 1961, PL 518 - creates a regional agency by intergovernmental compact for the planning, conservation, utilization, development, management, and control of the water and related natural resources of the Delaware River Basin; for the improvement of navigation, reduction of flood damage, regulation of water quantity, control of pollution, development of water supply, hydroelectric energy, fish and wildlife habitat, and public recreational facilities, and other purposes and defining the functions, powers, and duties of such an agency.

45. Act of August 16, 1961, PL 993, amended the Act of July 7, 1955, PL 258, by extending provisions of the act to authorize the sealing of abandoned coal mines and filling voids in abandoned coal mines and making money available heretofore appropriated for those purposes and retaining certain money for the control and drainage of water from anthracite coal formations.

46. Act of August 18, 1961, PL 998, amended the Act of December 15, 1959, PL 1779, by removing the license requirement on certain regulated fishing lakes; by further regulating the issuance of permits or bills of sale for fish caught in such lakes; and changed penalties relating to such lakes.

47. Act of August 22, 1961, PL 1032, amended the Act of December 15, 1959, PL 1779, by authorizing the Fish Commission to set aside certain waters to be used exclusively for fishing by children and disabled persons.

48. Act of September 2, 1961, PL 1194, amended the Act of June 27, 1947, PL 1095, known as "The Anthracite Strip Mining Law", by further regulating anthracite strip mining operations, changing provisions with respect to bonds, backfilling restoration permits and registration, including certain persons within the provisions of the act and imposed penalties.

49. Act of April 15, 1963, PL 17, amended the Act of August 6, 1936, PL 95, which authorizes and empowers cities, boroughs, towns, and townships to provide for protection against floods by erecting and constructing works and improvements; to expend moneys and incur indebtedness; to assess benefits against property benefited; to issue improvement bonds imposing no municipal liability; and to acquire, take, injure, or destroy property for such purposes, by authorizing municipalities to enter into arrangements, and agreements with other public authorities for the purpose of the act, removing the prohibition upon municipalities to construct dams for flood control or other purposes, and increasing the amount of works or improvements which may be let without competitive bidding and advertisement.

50. Act of July 16, 1963, P. 238, amended the Act of May 31, 1945, PL 1198, known as the "Bituminous Coal Open Pit Mining Conservation Act", by requiring all bituminous open pit mining operators to be licensed; requiring operators to obtain permits for each operation; requiring consent to certain acts by landowners; increasing the amount of bonds required; providing for the suspension of licenses; further regulating backfilling and planting; creating a Land Reclamation Board, and defining its powers and duties; creating a Bureau of Conservation and Reclamation within the Department of Mines and Mineral Industries; providing that citizens may institute proceedings to compel enforcement of the act; and imposing penalties and sanctions. NOTE: The Act of August 8, 1963, PL 623, further amended the above by making a technical change in one of the added provisions.

51. Soil and Water Conservation Law, Act 217, amended July 25, 1963, August 1, 1963, and August 8, 1963 was basically the same as the Soil Conservation Law of May 15, 1945. However, under the amendments, the title of the act was changed to include the words "and water". Another amendment struck the word "agricultural" from a proviso that local directors were to be nominated by "county-wide agricultural

organizations" while the third change permitted the appointment of a non-farmer director in counties which had been recognized by the State Soil and Water Conservation Commission (at the request of the local District) as an urbanizing district.

52. Act of August 13, 1963, PL 781, amended the Act of June 27, 1947, PL 1095, as amended, and known as "The Anthracite Strip Mining Law" by changing its title to "The Anthracite Strip Mining and Conservation Act". In addition, it redefines certain terms regulating the licensure of anthracite strip mining operators and the issuance of permits for strip mining operations; imposes fees, provides for the suspension of licenses; further regulates bonds and backfilling; authorizes the Secretary of Mines and Mineral Industries to make rules and regulations; imposes additional penalties; changes appeal procedures; creates a Land Restoration Board to determine the amount of backfilling or alternative use of land in certain cases; and creates a Bureau of Anthracite Conservation and Reclamation within the Department of Mines and Mineral Industries.

53. Act of August 14, 1963, PL 808, known as "The Motor Boat Law", amends the title and Act of May 28, 1931, PL 202. The act provides for the registration and regulation of motor boats operated or navigated upon any public stream, artificial or natural body of water, or any river within the Commonwealth; confers powers and imposes duties on certain police officers, the Pennsylvania Fish Commission, and the Navigation Commission for the Delaware River and its navigable tributaries, including the enforcement of existing laws; grants powers and imposes duties upon the Department of Revenue; and prescribes penalties.

54. Act of June 22, 1964, codifies, amends, revises, and consolidates the laws of the Commonwealth relating to eminent domain.

55. Act of June 22, 1964, Act #8, known as the "Project 70 Land Acquisition and Borrowing Act" authorizes the creation and liquidation of indebtedness of $70,000,000 for the acquisition of lands for recreation, conservation, and historical purposes (PROJECT 70); defines powers and duties of certain offices, agencies, and political subdivisions; provides for the allotment of proceeds including Commonwealth grants; provides for the payment in lieu of taxes; and prescribes standards and makes appropriations.

56. Act of May 7, 1965, Act #39, amended "The Second Class Townships Code", approved May 1, 1933, PL 103, by authorizing the acquisition of waterworks systems by such townships.

57. Act of June 8, 1965, Act #82, amended the Administrative Code of 1929, (Act of April 9, 1929, PL 177) by further prescribing the powers and duties of the Department of Mines and Mineral Industries in relation to abandoned coal mines, adding the power to close or backfill abandoned deep or strip coal mines, in addition to its former power to

seal, to fill voids, and extinguish fires in abandoned coal mines where such work is in the interest of the public welfare.

58. Act of July 19, 1965, Act #117, authorizes the Secretary of Mines and Mineral Industries to acquire, either amicably or by condemnation, certain lands affected by open or strip mining; authorizes the reclamation of such lands, and provides for the use or disposal thereof.

59. Act of July 19, 1965, Act #120, repeals the Act of March 20, 1818, PL 197, and the Act of February 13, 1822, PL 21, insofar as rights granted by the Act of March 20, 1818, PL 197 are confirmed to the Lehigh Coal and Navigation Company. This action was taken to clear up questions of jurisdiction and water rights on the Lehigh River.

60. Act of July 23, 1965, Act #133, amended the Act of June 28, 1951, PL 938, which required wells and cisterns to be covered or sealed, and provided penalties, by increasing the penalties.

61. Act of August 23, 1965, Act #194, amended the Act of June 22, 1937, PL 1987, as amended, commonly known as "The Clean Streams Law" making that title definite. The act redefines industrial wastes to include acid mine drainage; extends and increases penalties for the discharge of any industrial wastes into the waters of the Commonwealth; requires permits for the operation of coal mines and provides for the suspension or renovation of such permits; places responsibilities on landowners and land occupiers; and provides penalties. Certain exemptions relating to mine drainage discharged to streams which were already polluted were eliminated and the act declares it to be the policy of the Commonwealth ".....not only to prevent further pollution of the waters of the Commonwealth but also to clean and restore to a clean, unpolluted condition every stream in Pennsylvania that is presently polluted....."

62. Act of October 13, 1965, Act #309, amended The Administrative Code of 1929 (Act of April 9, 1929, PL 177), by further providing for the powers and duties of the Department of Mines and Mineral Industries, adding the power to drill or bore holes, dig ditches, etc. which would relieve flooding or acid conditions caused by mine water, and to extinguish fires in coal banks as well as abandoned mines where such work is in the interest of public welfare.

63. Act of October 21, 1965, Act #318, amended "The County Code", approved August 1, 1955, PL 323, by authorizing counties to borrow and appropriate money and enter into contracts for construction and operation of dams for the improved utilization of water resources.

64. Act of December 15, 1965, Act #410, grants to the Department of Mines and Mineral Industries certain duties and powers to initiate a program to alleviate pollution of streams from abandoned coal mines within the Commonwealth of Pennsylvania.

65. Act of January 13, 1966, Act #515, enables counties of the Commonwealth to covenant with landowners for preservation of land in farm, forest, water supply, or open space uses.

66. Act of January 24, 1966, Act #537, known as the "Pennsylvania Sewage Facilities Act" provides for the planning and regulation of community and individual and community sewage disposal systems; requires municipalities to submit plans for systems in their jurisdiction; authorizes grants to municipalities; requires permits for persons installing such systems; authorizes the Department of Health to adopt rules, regulations, standards and procedures; creates an advisory committee; provides remedies and prescribes penalties. This Act becomes effective July 1, 1967.

67. Act of May 5, 1966, Act #2, 1st Special Session, provides for the Commonwealth to enter into the Interstate Mining Compact to assure sound mining practices with other states of the United States which are signatories thereto, granting the Governor authority to execute such compact, and to serve as the official representative of the Commonwealth. The act also creates a Mining Practices Advisory Council in the office of the Governor. Two of the states purposes of the compact are (1) to advance the protection and restoration of land, water, and other resources affected by mining, and (2) to assist in the reduction or elimination or counteracting of pollution or deterioration of land, water, and air attributable to mining.

CASE LAW

1. The Supreme Court, in deciding that the larger streams of Pennsylvania, such as lakes, rivers, and creeks, were public waters said:

> "All rivers, lakes, and streams comprehended within the charter bounds of the province passed to William Penn in the same manner as the soil. In grants of tracts of vacant lands by him or his successors during the proprietory times, and by the Commonwealth since, streams not navigable, falling within the lines of a survey, were covered by it, and belong to the owners of the tract who might afterwards convey the body of the stream to one person, and the adjoining lands to another. (2 Pet. 64). When streams not navigable formed the boundary of such tract, the grantee acquired a title ad filum aquae. The larger rivers and principle streams by nature navigable belong to the Commonwealth as well as where there was no tide, as where the tide ebbed and flowed, contrary to the principles of common law, and of some of the state, in which, in all rivers and streams where the tides did not ebb and flow, the grant of land, with a boundary on the stream extended ad filum aquae (Carson v. Blazer, 2 Binn. 475; Shunk v. Schuylkill Navigation Company, 14 Sergt. & Rawle 71 (Early 1800's))."

2. The Supreme Court in the case of Ball vs. Slack, 2 Wharton 538, stated that it is a settled principle in Pennsylvania that when a grant or survey is bounded on a river or creek it extends to that river or creek and (except in a case of large navigable streams), extends to the middle of the creek.

3. Commonwealth of Pennsylvania, Water and Power Resources Board vs. Green Springs Co., 394 Pa. 1 (1958), held that the Board's power and authority to grant or withhold consent for a permit to build a dam does not violate Article II of the Pennsylvania Constitution, providing that legislative power shall be vested in a General Assembly.

4. Collegeville Borough vs. Philadelphia Suburban Water Co., 377 Pa. 636 (1954), held that the Board is not prevented from permitting the diversion of water from one watershed to another or from confining a water company to appropriation of waters within its franchised territory.

5. Lakeside Park Co. vs. Forsmark, 396 Pa. 389 (1959), held that Sandy Lake in Mercer County (27th in size among 254 lakes in Pennsylvania) is nonnavigable and private.

6. Commonwealth ex rel. Shumaker vs. New York and Pennsylvania Co., 367 Pa. 40 (1951). This case held that the "Clean Streams Law" did not provide an exclusive remedy and, therefore, the Commonwealth could proceed in equity to abate a nuisance caused by pollution.

7. Sanitary Water Board vs. City of Wilkes-Barre, 199 Pa. Superior Ct. 492. In this case, a Pennsylvania appellate court affirmed an order of the Sanitary Water Board requiring a municipality to discontinue the discharge of sewage and to construct treatment works. The decision of the Board was based on expert testimony presented at an administrative hearing to the effect that the untreated raw sewage discharged from the municipality would cause pollution to waters of the receiving stream.

8. In general, there have been a number of lower court decisions upholding orders of the Sanitary Water Board, e.g., Sanitary Water Board vs. Borough of Coudersport, 81 Dauphin 178 (1963), affirming an order requiring the construction of sewage treatment facilities, and Sanitary Water Board vs. Tri-County Fuel Co., 79 Dauphin 128 (1962), affirming an order refusing a permit to operate a coal mine. The latter case perhaps was especially significant because it clarified language in the "Clean Streams Law" relating to discharges of acid mine drainage. In essence, the case held that the Board could refuse a permit for an operation under which acid drainage would be discharged provided that the discharge would result in pollution.

WATER RIGHTS

Riparian Rights Doctrine: Riparian rights doctrine applies in Pennsylvania. This doctrine holds that the owner of land over which

a stream of water runs has a right to a reasonable use of water for the supply of his natural wants or for manufacturing purposes; however, he must so exercise his privilege as not to injure the rights of others.

Surface Water: "Surface Waters", as defined by our courts, are waters on the surface of the ground, usually caused by rain or snow, which are of casual or vagrant character, following no definite course and having no substantial or permanent existence.

Ground Water: Water which percolates through the earth but does not follow any well-defined channel belongs absolutely to the owner of the land over which it passes; but where it flows in a well-defined channel, either above or below the surface, the owner of the land over which it passes has only a qualified right to use it.

Access to Lakes and Streams: Ordinarily title to land abutting on a navigable stream extends to low water mark subject to the right of the public to navigation and fishing between low and high water mark, and in case of land abutting on creeks and nonnavigable rivers to the middle of the stream, but in case of nonnavigable lakes or bodies where the land under water is owned by others, no riparian rights attach to property bordering on the water and an attempt to exercise any such rights by invading the water is as much a trespass as if an unauthorized entry were made upon the dry land of others.

Diversion between Basins: Diversion of surface water between basins within the Commonwealth is largely controlled by the Water and Power Resources Board, either through the issuance of permits to public water supply companies or agencies, or, in the case of industry or others, through the issuance of permits under the Water Obstruction Act for intake and outflow structures associated with the diversion.

Eminent Domain: Public water supply companies are granted the right of eminent domain by the Act of June 24, 1939, PL 842, as amended; and public service companies holding a limited power permit or a limited water supply permit may appropriate and condemn lands under the Act of June 14, 1923, PL 700, as amended.

The Water and Power Resources Board may condemn lands for flood control purposes under the Act of August 7, 1936, PL 106, as amended; and under the Act of June 5, 1947, PL 422, as amended, the Department of Forests and Waters is authorized to condemn lands for stream clearance, rectification and improvement purposes. The Pymatuning Swamp Dam Act of May 2, 1929, PL 1530, as amended, and the Schuykill River Pollution Act of June 4, 1945, PL 1383, as amended, also conferred the power of eminent domain.

REGULATORY AUTHORITY (Permits or Approvals Required)

Drilling Wells: The Act of May 29, 1956, PL 1840 (1955), known as the Water Well Drillers License Act, defines and provides for the

licensing of water well drillers, prevention of pollution of underground waters; confers powers and imposes duties on the Department of Internal Affairs.

Impoundments and Channel Encroachments: It is unlawful to construct any dam or other water obstruction or to make any change or additions thereto, or to in any manner change or diminish the course, current, or cross-section of any stream or body of water except the tidal waters of the Delaware River and its navigable tributaries without first obtaining the written consent or permit of the Water and Power Resources Board upon written application to said board therefor.

"Water Obstruction" is defined as any dam, wall, wing-wall, wharf, embankment, abutment, projection, bridge or similar or analogous structure, or any other obstruction whatsoever, in, along, across, or projecting into or being in any stream or body of water. (See Act of June 24, 1913, PL 555, as amended.)

The Pennsylvania Fish Commission reviews channel changes in all streams and makes recommendations designed to safeguard fish life, to assure that proper channel depth is maintained for fish passage through the change area and to reduce excessive warming in trout streams.

Development in Flood Plains: Some small measure of control is possible in the application of the provisions of the above Water Obstruction Act. Under Pennsylvania law, the power of zoning is conferred on counties and municipalities in the various codes pertaining to these political subdivisions. Local zoning ordinances can include flood-plain zoning provisions and regulations.

Discharge of Wastes: Permits are required by the Sanitary Water Board for the construction of sewer systems, sewage treatment works, industrial waste treatment plants, the discharge of wastes, and the operation of mines.

Under Section 200 of the Pennsylvania Fish Law:

> "No person shall put or place in any waters within or on the boundaries of this Commonwealth any electricity, explosive or any poisonous substances whatsoever for the purpose of fish management, agents of or persons authorized by the Commission under the supervision of the Executive Director may use any method or means of eradication or control of fish. No person shall allow any substance of any kind or character, deleterious, destructive or poisonous to fish, to be turned into or allowed to run, flow, wash, or be emptied into any waters within this Commonwealth, unless it is shown to the satisfaction of the Commission or to the proper court that every reasonable and practical means has been used to abate and prevent the pollution of waters in question by the escape of deleterious substances."

Construction of Public Water Supply: Water company charters and water power and water supply permits are required by the Water and Power Resources Board under Section 5 of the Act of May 5, 1905, PL 385, and the Act of June 14, 1923, PL 704, as amended.

Permits are required by the Sanitary Water Board for the construction of water works, and these permits stipulate the conditions under which water may be served to the public.

REGULATORY AUTHORITY (Water Quality)

Waste Treatment: The basis for the Sanitary Water Board's sewage and industrial waste control program is a statewide system of stream classification. The streams are classified in accordance with the required minimum degree of treatment for sewage and sewagelike industrial wastes. Treatment classifications are: primary, intermediate, and complete. These classifications are defined in the Sanitary Water Board Rules and Regulations.

ADMINISTRATIVE STRUCTURE

Responsibility for the administration, management, development, and control of the Commonwealth of Pennsylvania's resources is vested in a number of different, and different types of, agencies.

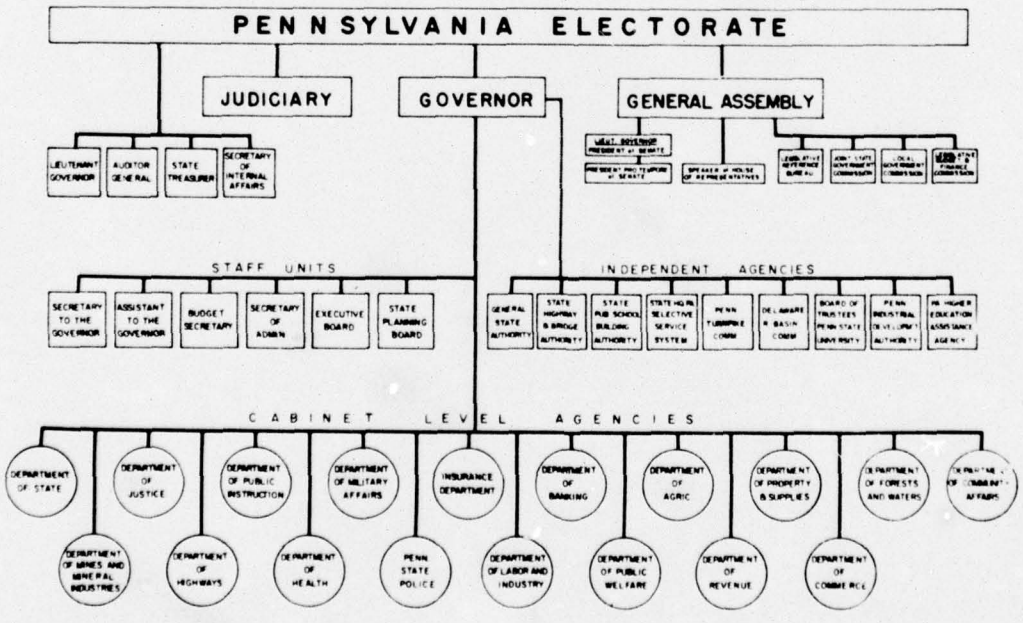
Fish and game are administered by separate agencies; Pennsylvania is the only state in which this total separation exists.

While the Sanitary Water Board is the chief water pollution abatement and control agency, the Fish Commission has certain police powers and may take summary court action relating to pollution that kills fish. The Department of Mines and Mineral Industries issues permits for the strip mining of bituminous coal, and is the enforcement arm of the Sanitary Water Board for the abatement of pollution caused by bituminous coal strip mine drainage. The Sanitary Water Board has all other pollution abatement and control authority. The Secretary of Health is the Board's chairman, and the Health Department's Division of Sanitary Engineering provides it with technical advice and service.

The Department of Forests and Waters develops, operates, and maintains most of the State parks, many of which contain natural or man-made lakes. The Fish Commission manages the fishery resources of these waters, including fish law enforcement.

PLATE I

PENNSYLVANIA STATE GOVERNMENT ORGANIZATION



The Department of Forests and Waters operates the State forest system. The Game Commission owns large acreages of State game lands, mostly in forest cover. These tracts are managed as wildlife habitat areas for propagation of wildlife and public hunting. Forest management is practiced when compatible with wildlife management programs.

The State Planning Board has been charged with the responsibility of overall planning for proper economic and physical development of the State. A program of considerable magnitude is underway that will lead to the preparation of a Comprehensive General Development Plan that will relate all the programs of the State to agreed upon overall objectives.

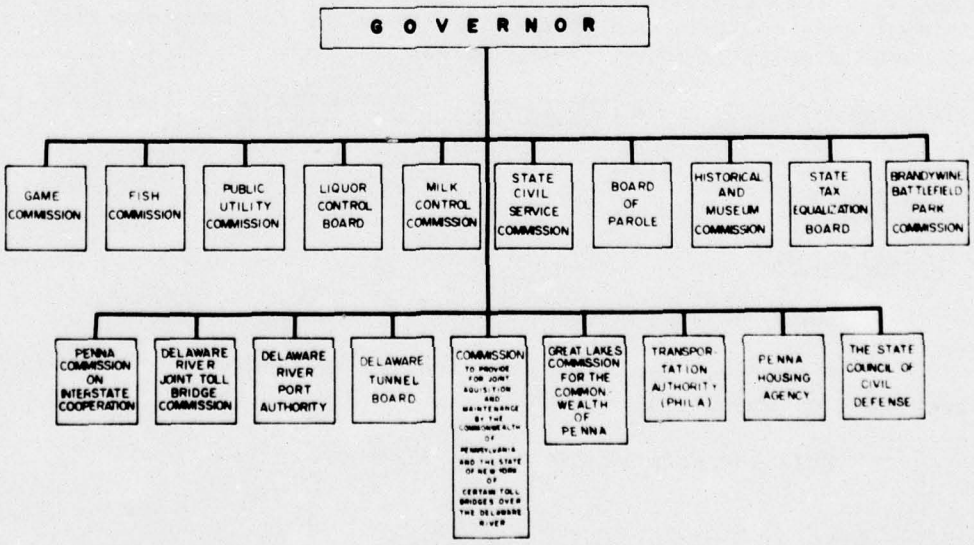
The Pennsylvania Historical and Museum Commission administers museums and historic properties, some of which include forested land.

While the four primary agencies in the outdoor recreation field - Forests and Waters, Fish and Game Commissions, and the Historical and Museum Commission - prepare and distribute literature and monthly periodicals relating to the properties they administer, a bureau in the Department of Commerce also carries on promotional activities to attract more recreation seekers to the Commonwealth.

There is statutory coordination between agencies in certain fields. For example, the heads of five resource-oriented agencies sit ex officio as members of the Sanitary Water Board. Coordination under law is provided in the case of strip mining bituminous coal, as indicated previously. High ranking agency officials also constitute the membership of the Water and Power Resources Board in the Department of Forests

PLATE 2

BOARDS & COMMISSIONS UNDER THE GOVERNOR'S JURISDICTION



and Waters. This Board has jurisdiction over such matters as dams and encroachments, and the withdrawal of public water supplies from streams.

In most other matters concerning relationships and communication, the organizational structure of the Commonwealth government has created a situation under which voluntary systems of interagency coordination have become important.

In addition to the agencies already named, others with resources interest include the Department of Agriculture (through the Soil and Water Conservation Commission), the Department of Internal Affairs, and the Department of Highways.

A new Department of Community Affairs came into existence on July 1, 1966. Among its powers and duties are the coordination of the many programs of grants and subsidies paid to political subdivisions by various agencies of the State and Federal Government, and wherever provided by law, the supervision and administration of the various programs of State and federal assistance and grants.

The Secretary of Forests and Waters has been designated by the Governor as the water resources coordinator for the Commonwealth.

The "Pennsylvania State Government Organization" chart was extracted from Volume 96, The Pennsylvania Manual, 1963-64.

The foregoing introductory paragraphs and the following material, setting forth the nature of the interest or responsibility of various Pennsylvania agencies in resource matters and the avenues of cooperation and coordination presently being employed, were extracted from Resources - Responsibility and Coordination Related to the Comprehensive Study of the Susquehanna River Basin, published by the Interstate Advisory Committee on the Susquehanna River Basin, 1965, with minor changes. The responsibilities, intrastate coordination, and state-federal relationships are essentially the same for comprehensive water resource studies in other river basins.

STATE DEPARTMENTS, AGENCIES, BOARDS, AND COMMISSIONS: See following pages.

FLOOD CONTROL

Agencies:

Department of Forests and Waters

Water and Power Resources Board (The Chairman of the Board is the Secretary of Forests and Waters).

Soil and Water Conservation Commission

State Planning Board

Department of Community Affairs

General State Authority

Responsibility:

The Department of Forests and Waters makes flood protection feasibility studies; it designs and installs flood protection structures; it reviews plans of others for the construction of dams, channel encroachments and channel changes for the guidance of the Water and Power Resources Board. It acts as liaison between the U.S. Corps of Engineers and local agencies regarding flood plain information studies, and reviews such studies. The Department manages state forest lands for watershed protection and runoff retardation.

The Water and Power Resources Board reviews applications for permission to construct dams (including those built by State agencies), channel encroachments, and channel changes including those connected with the building and maintenance of roads and bridges. It issues permits for these, upon approval. It assumes a share of the local costs of flood protects constructed along Commonwealth streams by the Corps of Engineers, and cooperates with the U.S. Weather Bureau and U.S. Geological Survey in the operation and maintenance of the federal-state Flood Forecasting Service. It establishes flood control districts within the Commonwealth as required, and constructs local flood protection projects therein. The Division of Dams and Encroachments of the Department of Forests and Waters is the service arm of the Water and Power Resources Board.

The Soil and Water Conservation Commission has coordination functions and approves PL 566 (small watershed) projects that include flood protection measures, and sets priorities. Land management for runoff retardation is involved in such projects, and in operations of soil and water conservation districts, which the Soil and Water Conservation Commission supervises.

The State Planning Board is concerned with flood control and land development as part of its State planning responsibility.

The Department of Community Affairs acts in liaison capacity with local and regional agencies in flood-plain planning.

The General State Authority designs, budgets, and allocates funds from bond sales, and serves as a contract-letting agency for Commonwealth flood protection projects specifically designated by the General Assembly.

Intrastate Coordination:

The Department of Forests and Waters with the Departments of Health, Commerce, Highways, Mines and Mineral Industries, the Fish and Game Commissions, and the State Planning Board as to Corps of Engineers projects; the Department of Forests and Waters with these and the Soil and Water Conservation Commission, of which the Secretary of Forests and Waters is a member, on PL 566 projects; with the Department of Public Instruction on the location and safety of schools in flood plains; with the General State Authority on State flood protection works.

The Department of Forests and Waters and the Water and Power Resources Board coordinate with the Fish and Game Commissions as to impounding structures built by them, even though no appreciable flood control features are built into their structures except in the case of impoundments built jointly by the Fish Commission and the U.S. Soil Conservation Service in PL 566 projects; with the Fish Commission as to structures or activities affecting stream channels; with the Department of Health where there is a connection between flood waters and public water supply; and with the Department of Internal Affairs as to the geology of dam sites.

There is coordination between the Department of Community Affairs and the State Planning Board regarding flood plains.

The Soil and Water Conservation Commission coordinates on PL 566 projects with all the agencies named in this subsection.

The Fish Commission, as well as the Department of Forests and Waters, coordinates with the General State Authority regarding structures built in their names.

Interstate:

Most agencies named in this report communicate with each other on basin matters. Pennsylvania agencies communicate with other basin state agencies having related functions when the need arises, and all may do so with the Council of the State Governments. This situation prevails as to all subjects treated, and will not be repeated except by reference unless special conditions warrant mention.

State-Federal:

The Secretary of Forests and Waters is the Governor's designated representative for liaison with the Corps of Engineers in flood control matters. The Department of Forests and Waters and the Water and Power Resources Board coordinate with the Corps of Engineers, Federal Power Commission, Geological Survey, Weather Bureau, and Soil Conservation Service.

The Soil and Water Conservation Commission coordinates with the Soil Conservation Service.

Less obvious flood retarding or reducing effects result from direct or indirect activities of the Forest Service, the Cooperative Extension Service, and the Agriculture Stabilization and Conservation Service. State-federal coordination here is more or less incidental to other matters, hence it is not set forth in specific terms.

The Department of Community Affairs coordinates with the U.S. Department of Commerce, U.S. Department of Housing and Urban Development, and Soil Conservation Service.

WATER POLLUTION CONTROL

Agencies:

Sanitary Water Board

Department of Health (The Secretary of Health is the Chairman of the Sanitary Water Board)

Department of Mines and Mineral Industries

Fish Commission

Department of Community Affairs

Responsibility:

The Sanitary Water Board's responsibilities are broad and general; it is the chief state pollution control agency. The Division of Sanitary Engineering of the Department of Health is the service arm of the Sanitary Water Board in all matters under its jurisdiction except the program to control pollution caused by drainage from bituminous coal strip mines; the Department of Mines and Mineral Industries is the Board's service arm with regard to this type of water pollution.

The Department of Mines and Mineral Industries also fosters and aids research into the subject to coal mine drainage pollution.

The Fish Commission has certain enforcement powers in pollution involving the killing of fish.

Sewer facility planning is required by the Department of Community Affairs in all Urban Planning Assistance program studies.

Intrastate Coordination:

The Secretaries of Health, Forests and Waters, Mines and Mineral Industries, and Commerce are ex officio members of the Sanitary Water Board, as is the Executive Director of the Fish Commission.

Interstate:

See "Flood Control".

State-Federal:

The Department of Health coordinates with the Federal Water Pollution Control Administration, the Department of Mines and Mineral Industries with the Bureau of Mines, and the Fish Commission with the Fish and Wildlife Service.

The Department of Health also coordinates with the Atomic Energy Commission on disposal of wastes from nuclear sources, for the Sanitary Water Board.

PUBLIC AND INDUSTRIAL WATER SUPPLY

Agencies:

Department of Health

Water and Power Resources Board

Soil and Water Conservation Commission

Public Utility Commission

Department of Community Affairs

Responsibility:

The Department of Health has responsibility over the quality of a public water supply.

The Water and Power Resources Board has jurisdiction over the quantity of public water that may be withdrawn from a stream and over the issuance of permits for public or industrial water intake and outfall structures so far as they may encroach on streams.

The Soil and Water Conservation Commission has coordination functions in cases where water supply is a feature of a PL 566 project.

The Public Utility Commission passes on rate structures.

Water supply and distribution facility planning is required by the Department of Community Affairs in all Urban Planning Assistance program studies.

Intrastate Coordination:

The Water and Power Resources Board coordinates with the Fish Commission as to the effects on aquatic resources of water withdrawals from streams.

The Secretary of Health and the Executive Director of the Fish Commission are ex officio members of the Water and Power Resources Board, of which the Secretary of Forests and Waters is Chairman.

The Secretary of Forests and Waters also is a member of the Soil and Water Conservation Commission, which facilitates coordination in PL 566 water supply projects.

Interstate:

See "Flood Control".

State-Federal:

The Department of Health routinely coordinates with the Federal Water Pollution Control Administration, and with the Soil Conservation Service where water supply may be a feature of a PL 566 project.

The Water and Power Resources Board, directly or through the Department of Forests and Waters, coordinates with the Corps of Engineers as to water supply features of multiple-purpose impoundments, with the Soil Conservation Service as to water supply features of PL 566 projects, and with the Geological Survey as to stream flow data.

The Soil and Water Conservation Commission coordinates with the Soil Conservation Service in connection with PL 566 projects.

HYDROELECTRIC POWER

Agencies:

Water and Power Resources Board

Fish Commission

Responsibility:

The Water and Power Resources Board reviews and approves hydro-construction projects.

The Fish Commission makes determination of the need of fishways at hydro-power structures.

Intrastate Coordination:

The Secretary of Forests and Waters, the Secretary of Health, the Executive Director of the Fish Commission, and a member of the Public Utility Commission constitute the Water and Power Resources Board.

Interstate:

See "Flood Control".

State-Federal:

The Water and Power Resources Board coordinates with the Corps of Engineers and the Federal Power Commission.

The Fish Commission coordinates with the Fish and Wildlife Service and the Game Commission makes a study of the wildlife values.

WATERSHED DEVELOPMENT (Including Irrigation and Drainage)

Agencies:

Department of Forests and Waters

Soil and Water Conservation Commission

State Planning Board

Department of Commerce

Department of Community Affairs

Department of Highways

Fish Commission

Game Commission

Department of Mines and Mineral Industries

Department of Health

Department of Internal Affairs

Responsibility:

The heading of this section is so broad that virtually every agency of Pennsylvania State government that deals with resources in any way could be said to participate.

Watershed development is inherent in the functions of the Department of Forests and Waters; specific responsibilities are found in other pages of this series relating to timberland and water.

The Soil and Water Conservation Commission has liaison and coordination functions, and approves PL 566 projects; it serves and advises soil and water conservation districts.

The broad scale work of the State Planning Board tends to stimulate watershed development, directly or indirectly.

Industrial, economic development, and tourism responsibilities of the Department of Commerce have a similar impact.

The community development responsibilities of the Department of Community Affairs also guide and stimulate watershed development.

The influence of the Department of Highways is largely one of access.

Both the Fish and Game Commission contribute through fishery and wildlife betterment programs and development of recreation facilities. The Game Commission has responsibility for management of state game lands, actively sponsors waterfowl area development, offers technical aid in development of wildlife aspects of watershed work plans, and operates a cooperative farm-game program.

The Department of Mines and Mineral Industries aids through market stimulation, research assistance, improved mining techniques, spoil area reclamation, abatement of pollution from abandoned mines, and related activities.

The Department of Health assists through water supply and water pollution control functions, in the latter case through the Sanitary Water Board.

The Department of Internal Affairs through its Geological Survey defines the geology and mineral resources of the respective areas and establishes the availability of ground water in the various rock types within the watersheds.

Intrastate Coordination:

Each of the named agencies coordinates to some degree with all of the others where there is an interplay of action, not all of which are listed here. The Department of Forests and Waters and the Game Commission as to forests and game management; the Department of Forests and Waters coordinates with the Soil and Water Conservation Commission on PL 566 projects, with the Fish Commission on fish management programs of park and state forest waters, with the Department of Mines and Mineral Industries on reclamation of spoil areas, with the Department of Health on water supply matters, etc., the Department of Community Affairs has functions in connection with PROJECT 70, which implies coordination with the Department of Forests and Waters, State Planning Board, Fish Commission, Game Commission, and others; in other contexts the Department of Commerce coordinates with the Soil and Water Conservation Commission, Department of Highways, and Department of Forests and Waters. The Department of Highways coordinates with the Fish and Game Commissions to minimize losses of fish and wildlife as a result of highway construction activities. The Soil and Water Conservation Commission lists the Department of Public Instruction as a cooperating agency in its soil and water conservation district program.

Interstate:

See "Flood Control".

State-Federal:

The Department of Forests and Waters coordinates with the Forest Service, Soil Conservation Service, Corps of Engineers, Geological Survey, and Bureau of Outdoor Recreation.

The Soil and Water Conservation Commission coordinates with the Soil Conservation Service, the Cooperative Extension Service, occasionally with other federal agencies in the Department of Agriculture, and with the Geological Survey.

The Department of Community Affairs maintains liaison with the U.S. Department of Commerce, U.S. Department of Housing and Urban Development, and the Soil Conservation Service; the Department of Highways does so with the Bureau of Public Roads; the Fish and Game Commissions do so with the Fish and Wildlife Service and the Bureau of Outdoor Recreation; the Department of Mines and Mineral Industries coordinates with the Bureau of Mines; and the Department of Health does so with the Federal Water Pollution Control Administration.

ECONOMIC DEVELOPMENT

Agencies:

Department of Commerce

Department of Community Affairs

State Planning Board

Department of Forests and Waters

Department of Mines and Mineral Industries

Department of Highways

Department of Health

Fish Commission

Game Commission

Soil and Water Conservation Commission

Historical and Museum Commission

Department of Internal Affairs

Responsibility:

As in the case of watershed development, almost every Pennsylvania State agency may be said to contribute to economic development in one or more ways.

The Department of Commerce has promotional and financial aid functions. The Department also administers the Appalachian and Economic Development Act programs in Pennsylvania.

The Department of Community Affairs has planning functions.

Broad scale planning is done by the State Planning Board.

The functions of the Department of Forests and Waters have impact on timber, water, and recreational resources.

The Department of Mines and Mineral Industries provides technical aid to the mining industries of the Commonwealth.

The Department of Highways facilitates transportation.

The Department of Health's functions relate to water supply and water pollution control, in the latter case through the Sanitary Water Board.

The Fish and Game Commissions have development and management responsibilities relating to fishing and hunting recreation; the Fish Commission also has boating responsibility.

The Soil and Water Conservation Commission assists mainly through its PL 566 functions and aid to soil and water conservation districts.

The Historical and Museum Commission develops and manages museums and historic properties, and certifies to the authenticity of historic districts established by counties, townships, or municipalities.

The Department of Internal Affairs' Geological Survey maps and records the mineral resources available for economic development and also establishes the availability of ground water for development.

Intrastate Coordination:

The Department of Commerce coordinates primarily with the State Planning Board, the Department of Forests and Waters, the Department of Mines and Mineral Industries, the Department of Highways, the Department of Health, and the Department of Labor and Industry.

The Department of Community Affairs coordinates with many State agencies in matters concerning economic development.

The State Planning Board and the Department of Forests and Waters coordinate with all agencies named.

The Department of Mines and Mineral Industries coordinates with the Department of Commerce, and to some degree with the State Planning Board, the Department of Forests and Waters, the Department of Health, and the Fish Commission.

The Department of Highways coordinates with the Department of Commerce, the State Planning Board, the Department of Forests and Waters, and the Fish and Game Commissions.

The Soil and Water Conservation Commission coordinates with the same agencies named under Watershed Development.

Interstate:

See "Flood Control".

State-Federal:

Coordination is as follows:

The Department of Commerce with the U.S. Department of Commerce, the Department of Defense, the Small Business Administration, and other federal agencies.

The Department of Community Affairs with the U.S. Department of Agriculture and the U.S. Department of Housing and Urban Development.

The Department of Forests and Waters with the Forest Service, the Soil Conservation Service, the Corps of Engineers, the Geological Survey, the Federal Power Commission, the Weather Bureau, and the Bureau of Outdoor Recreation.

The Department of Mines and Mineral Industries with the Bureau of Mines.

The Department of Highways with the Bureau of Public Roads.

The Department of Health with the Public Health Service.

The Fish and Game Commissions with the Fish and Wildlife Service and the Bureau of Outdoor Recreation.

The Historical and Museum Commission with the National Park Service and the Bureau of Outdoor Recreation.

RESOURCES RESEARCH AND PLANNING

Agencies:

State Planning Board

Department of Commerce

Department of Community Affairs

Department of Forests and Waters

Fish Commission

Game Commission

Department of Mines and Mineral Industries

Department of Health

Department of Highways

Soil and Water Conservation Commission

Historical and Museum Commission

Department of Internal Affairs

Responsibility:

Natural resources are among the factors given consideration in the broad gauge studies of the State Planning Board. The Board is charged with the responsibility of submitting recommendations to the Governor on each project undertaken through PROJECT 70.

The Department of Commerce has research functions concerning economic development.

The Department of Community Affairs furnishes planning aid to local and regional agencies and administers a part of the PROJECT 70 program.

The Department of Forests and Waters has planning and research functions concerning forests, parks, and water resources, and administers a part of the PROJECT 70 program.

The Fish Commission is the chief planning and research agency for fisheries, access to waters, and boating, and administers a part of the PROJECT 70 program.

The Game Commission's responsibility is to protect, propagate, manage, and preserve the game, fur-bearing animals, and protected birds of the Commonwealth and to enforce, by proper action and proceedings, the laws of the Commonwealth relating thereto. An active research division, along with a land management division to plan and implement beneficial wildlife programs are important functions of the Commission. A land acquisition program aids in fulfilling the responsibility of the Game Commission. Planning programs that consider future problems and solutions in the field of wildlife management are currently underway. The Commission administers a part of the PROJECT 70 program.

The Department of Mines and Mineral Industries provides a planning and research aid to the mineral industries of the Commonwealth.

The responsibilities of the Department of Health relate to water pollution control and water supply.

The Department of Highways keeps accessibility of the State's resources and fish and wildlife habitat in mind in planning highway locations.

The Soil and Water Conservation Commission furnishes planning aid to landowners through local soil and water conservation districts; it is consulted in planning stages of PL 566 projects.

The Historical and Museum Commission is concerned in the preservation of the resources represented by historic buildings, sites, and areas, and is consulted by other State agencies, local governments, and by private organizations for information and advice in this field.

The Department of Internal Affairs' Geologic Survey systematically maps the rock formation across the State, studies and records available and potential mineral and water resources, and arranges for topographic mapping. It assists other State, federal, and municipal agencies with problems relating to the aforementioned subjects.

Intrastate Coordination:

The State Planning Board coordinates with the other agencies named.

The Department of Commerce coordinates with the Departments of Forests and Waters, Health, Highways, Mines and Mineral Industries, and the Soil and Water Conservation Commission.

The Department of Community Affairs coordinates with other State agencies, including the Departments of Agriculture, Commerce, Forests and Waters, Health, Highways, and Mines and Mineral Industries.

The Department of Forests and Waters coordinates with the other agencies named.

Coordination by the Fish Commission is chiefly with the Department of Forests and Waters, Department of Health, the Department of and the Game Commission.

Coordination by the Game Commission is primarily with the Department of Forests and Waters as to game lands timber management, and with the Department of Highways in habitat matters.

Interstate:

See "Flood Control".

State-Federal:

The Department of Commerce coordinates with the U.S. Department of Commerce and other federal agencies, particularly in connection with

the administration of the Appalachian and Economic Development Act programs.

The Department of Community Affairs coordinates with the U.S. Department of Housing and Urban Development.

The Department of Forests and Waters coordinates with the Forest Service, Corps of Engineers, Federal Power Commission, Geological Survey, Weather Bureau, and Soil Conservation Service.

The Fish and Game Commissions coordinate with the Fish and Wildlife Service and the Bureau of Outdoor Recreation.

Principal coordination by the Department of Mines and Mineral Industries is with the Bureau of Mines.

The Department of Health coordinates with the Public Health Service and the Federal Water Pollution Control Administration.

The Department of Highways coordinates with the Bureau of Public Roads.

The Soil and Water Conservation Commission coordinates with the Soil Conservation Service, the Cooperative Extension Service, and the Geological Survey.

The Historical and Museum Commission coordinates with the Bureau of Outdoor Recreation and the National Park Service.

RECREATION (Including Fish and Wildlife)

Agencies:

Department of Forests and Waters

Fish Commission

Game Commission

Department of Commerce

Department of Community Affairs

Department of Health and Sanitary Water Board

Department of Highways

Independent Park Commissions

State Planning Board

Soil and Water Conservation Commission

Historical and Museum Commission

Responsibility:

The Department of Forests and Waters administers the State parks and State forests programs, including overall fiscal administration of the PROJECT 70 program, and that part of the program earmarked for acquisition of State and regional parks.

The Fish Commission has responsibility over fishing and recreational boating and administers that part of the PROJECT 70 program earmarked for the acquisition of fishing areas.

The Game Commission administers the laws relating to hunting, administers the State game lands, and leases land for public hunting. The Game Commission also administers that part of the PROJECT 70 program earmarked for acquisition of hunting areas.

The Department of Commerce provides promotional aid.

The Department of Community Affairs provides promotional and local planning aid, supervises a matching fund phase of PROJECT 70, administers the local grant-in-aid portion of the Federal Land and Water Conservation Fund, and provides local and regional recreation consulting services for local park site selection, planning, and development.

The Department of Health issues permits to public bathing places; the Sanitary Water Board controls water quality at recreation areas through its water pollution abatement and control authority.

Access to recreation areas is incidental to the overall road program of the Department of Highways.

The State Planning Board has prepared, in coordination with the various State agencies, a Statewide Outdoor Recreation Plan for Pennsylvania. The Executive Director of the State Planning Board has been designated by the Governor as the coordinating and liaison officer for the State in the utilization of funds made available through the Land and Water Conservation Fund Act.

The Soil and Water Conservation Commission passes on PL 566 projects that include recreation, and is concerned through its coordination functions with recreation features of activities in the soil and water conservation districts.

The Historical and Museum Commission administers museums and historic properties, including two historical museums in areas which are otherwise administered by the Department of Forests and Waters.

Intrastate Coordination:

The Department of Forests and Waters coordinates with the Fish Commission on fish management and boating in State parks and in other

waters supervised by the Department, on the impacts of channel changes, encroachments and dams; with the Game Commission on management of timbered State game lands, and on hunting on State forest and park lands with the Department of Commerce on the promotion of recreation and tourism; with the Department of Health on water supply quality at its recreation areas; with the Department of Highways as to road location and maintenance; with the State Planning Board as to long range plans for the Commonwealth; with the Soil and Water Conservation Commission as to selected recreation features of PL 566 projects; with the Department of Internal Affairs as to the geology of recreation dam sites; and with the Historical and Museum Commission as to historical preservation aspects of State forest and park areas.

The Fish Commission coordinates with the Department of Forests and Waters as indicated above; with the Game Commission as to fishing and boating at State waterfowl waters, and as to law enforcement; with the Department of Commerce on promotional tourism; with the Department of Health on water pollution control; with the Department of Highways on waters affected by road and bridge construction and maintenance; with the Soil and Water Conservation Commission on waters created in PL 566 projects; and with the Department of Internal Affairs on the Geology of potential fishing lake sites.

The Game Commission coordinates with the Department of Forests and Waters and the Fish Commission as indicated above; with the Department of Commerce on tourism promotion; with the Department of Highways on wildlife and wildlife habitat affected by road operations.

Intrastate coordination involving the Departments of Commerce, Health, and Highways, the State Planning Board, and the Soil and Water Conservation Commission has been indicated in the paragraphs above.

Interstate:

See "Flood Control".

State-Federal:

The Department of Forests and Waters coordinates with the Forest Service, Corps of Engineers, Geological Survey, Weather Bureau, Bureau of Outdoor Recreation, and Soil Conservation Service.

The Fish and Game Commissions coordinate with the Fish and Wildlife Service, Bureau of Outdoor Recreation, Bureau of Public Roads, and Extension Service; the Fish Commission coordinates also with the Soil Conservation Service and the Public Health Service.

The Department of Community Affairs coordinates with the U.S. Department of Housing and Urban Development and the U.S. Department of the Interior, Bureau of Outdoor Recreation.

The Department of Health coordinates with the Public Health Service and the Federal Water Pollution Control Administration.

The Department of Highways coordinates with the Bureau of Public Roads.

The Soil and Water Conservation Commission coordinates with the Soil Conservation Service and the Extension Service.

The Historical and Museum Commission coordinates with the National Park Service and the Bureau of Outdoor Recreation.

FOREST LAND MANAGEMENT

Agencies:

Department of Forests and Waters

Game Commission

Soil and Water Conservation Commission

Responsibility:

The Department of Forests and Waters manages state forest lands, operates tree nurseries, carries out research, forest fire prevention and control functions, and through the federal-state forestry program furnishes assistance to the owners of private woodlands.

The Game Commission manages State game lands as wildlife habitat areas and includes forest management when compatible.

The Soil and Water Conservation Commission has liaison functions concerning woodland owners through the soil and water conservation districts.

Intrastate Coordination:

The Game Commission uses timber growth and other statistical data furnished by the Department of Forests and Waters in forest management on State game lands. The Game Commission also cooperates with the Department of Mines and Mineral Industries on revegetation of mine spoil banks.

The Department of Forests and Waters coordinates with the Department of Mines and Mineral Industries on the reforestation of spoil banks reclaimed by the State.

Interstate:

See "Flood Control".

State-Federal:

The Department of Forests and Waters coordinates with the Forest Service, and with the Agricultural Stabilization and Conservation Service regarding cost-sharing practices on management of privately-owned woodlands.

The Game Commission is also active concerning agricultural stabilization and conservation programs on woodlands.

PORTS AND NAVIGATION (Including Recreational)

Agencies:

Department of Forests and Waters

Fish Commission

Water and Power Resources Board

State Planning Board

Responsibility:

The Fish Commission builds and maintains areas for public access to waters for recreational use and administers the State Boating Law.

The Water and Power Resources Board passes on encroachments by marinas on streams, and on marina construction standards, with staff assistance from the Department of Forests and Waters.

As part of its state planning activity, the State Planning Board has been concerned with the planning of port facilities and waterway systems.

Intrastate Coordination:

There is statutory coordination between the Fish Commission and the Water and Power Resources Board; the Executive Director of the Fish Commission is a member of the Board and the Secretary of Forests and Waters is its Chairman.

Interstate:

See "Flood Control".

State-Federal:

The Fish Commission coordinates with the Coast Guard as to boating and the marking of channels, and with the Bureau of Outdoor Recreation.

INTERSTATE COMPACTS, AGENCIES, AND COMMITTEES

The Commonwealth of Pennsylvania has long recognized the value of working in close unity with her sister states to solve mutual water and related land resource problems and to insure proper conservation, development, management, and control of those resources, particularly on interstate lakes and streams.

Indeed, as early as 1786, the Commonwealth and the State of New Jersey, by concurrent legislation, entered into a compact or treaty designed to settle jurisdictional questions concerning that portion of the Delaware River separating the two states and to distribute the islands in the Delaware River between the two states.

Pennsylvania-Ohio Pymatuning Compact: This compact is an agreement between Pennsylvania and Ohio designed to conserve, protect, and regulate the waters of, and flowing from, the Pymatuning Reservoir (Ohio and Pennsylvania), and to provide for uniform use of the reservoir for hunting, fishing, and general recreation.

The compact is administered by the Pennsylvania Water and Power Resources Board and the Director of the Ohio Department of Natural Resources, and prohibits pollution, regulates fishing and the operation of boats; establishes game and fish sanctuaties; and provides for reciprocal use of hunting and fishing licenses issued by either state, as well as concurrent jurisdiction upon the waters of the reservoir by proper law enforcement officers.

Releases from the reservoir to augment the flow of the Shenango and Beaver Rivers are controlled by the Water and Power Resources Board.

Ohio River Valley Water Sanitation Commission: The Commonwealth is one of the eight member states (Illinois, Indiana, Kentucky, New York, Ohio, Virginia, West Virginia, and Pennsylvania) of the Ohio River Valley Sanitation Commission, created in 1948 for the purpose of coordinating the efforts of the states in a regional water pollution control program.

The Commission, which has legal power to enforce its water quality standards, collects water quality data; makes technical studies and investigations; carries on educational activities; and promulgates regulations designed to prevent and abate pollution of the river and its tributaries.

Commission membership includes three members from each state appointed by the Governors and three members appointed by the President of the United States.

Interstate Commission on the Potomac River Basin: This compact commission is made up of three members each from Maryland, Virginia, West Virginia, Pennsylvania, the District of Columbia, and the United

States. It performs almost the same functions for the Potomac River Basin as ORSANCO does for the Ohio River Basin. However, while it suggests water quality objectives for the Basin, it does not have enforcement powers. Pennsylvania's members are appointed by the Governor.

Great Lakes Commission: The Great Lakes Commission was created in 1955 as a consultative, advisory, and recommendatory agency by compact between the Great Lakes states (Illinois, Indiana, Michigan, Minnesota, New York, Ohio, Wisconsin, and Pennsylvania). The Commission has no enforcement powers and serves as a joint forum for the airing of mutual problems concerning the Great Lakes; as a clearing house for information; and prepares special studies, bulletins, and reports for the use of member states concerning the Great Lakes development. Pennsylvania's enabling legislation provides for the appointment of three commissioners by the Governor.

Delaware River Basin Commission: The Delaware River Basin Commission was created in 1961 by compact by the Federal Government and the States of New York, New Jersey, Delaware, and Pennsylvania to plan, develop, conserve, manage, and control the water and related land resources of the Delaware River Basin. This Commission has broad planning and implementation powers and is the only interstate agency in which the Federal Government is in equal partnership with the states involved. Its five members are the Governors of the four signatory states and the Secretary of the U.S. Department of the Interior.

Interstate Advisory Committee on the Susquehanna River Basin: The Interstate Advisory Committee on the Susquehanna River Basin is a temporary committee supported by Maryland, New York, and Pennsylvania to coordinate the activities of the three states and appropriate State and federal agencies in the Susquehanna River Basin; to assist in the formulation and implementation of plans for the development and proper management and use of the water and related land resources of the basin, and to study and recommend legislation for the creation of a permanent intergovernmental agency for the proper management and effective utilization of the water and related land resources of the basin. Further, the Committee may undertake studies of the basin and its problems where necessary. Membership of the Committee is made up of two legislative appointees and two appointees of the Governors of each state.

Potomac River Basin Advisory Committee: The Potomac River Basin Advisory Committee was created in 1965 by the Governors of Maryland, West Virginia, Virginia, and Pennsylvania and the President of the Board of Commissioners of the District of Columbia with objectives similar to those of the Interstate Advisory Committee on the Susquehanna River Basin. In addition, the Committee works directly with the Federal Interdepartmental Task Force on the Potomac which is restudying the water and related land resources of the basin and acts as direct liaison between the Governors and the Task Force. There are three

members from each state and the District of Columbia appointed by the Governors and the President of the Board of Commissioners, respectively.

Susquehanna River Basin Study Coordinating Committee, Ohio River Basin Study Coordinating Committee, Genesee River Basin Study Coordinating Committee, Water Development Coordinating Committee for Appalachia, and the North Atlantic Region Water Resources Study Coordinating Committee: These coordinating committees are temporary committees formed to provide liaison between the state agencies and their federal counterparts on current comprehensive studies of the water and related land resources of the respective basins and regions that serve as a forum through which the State and federal agencies may keep abreast of the progress of the studies and furnish a medium through which the data and material and expertise may be exchanged and incorporated in the studies.

Appalachian Regional Commission: Pennsylvania is one of the 12 member states of the Appalachian Regional Commission. The purpose of the Commission is to assist the region in meeting its special problems, to promote its economic development, and to establish a framework for joint federal and state efforts toward providing the basic facilities essential to its growth and attacking its common problems and meeting its common needs on a coordinated and concerted regional basis. The Governor of each of the 12 states and a federal representative constitute the Appalachian Regional Commission. Section 206 (a) of the Appalachian Regional Development Act of 1965 authorized and directed the Secretary of the Army to prepare a comprehensive plan for the development and efficient utilization of the water and related resources of the Appalachian region, giving special attention to the need for an increase in the production of economic goods and services within the region as a means of expanding economic opportunities and thus enhancing the welfare of its people. Pennsylvania is cooperating with the Corps of Engineers in undertaking the studies necessary to develop this comprehensive plan.

SPECIAL PURPOSE DISTRICTS

Flood Control Districts: Flood Control Districts are established by the Water and Power Resources Board of the Department of Forests and Waters in order to construct flood control projects and cooperate with municipal governments and provide funds for the sharing of local costs on federal flood control projects.

> "The Water and Power Resources Board shall have power on its own motion, or upon the petition of at least three municipalities, or upon the petition of at least three hundred persons, who are freeholders, in any drainage area, to make appropriate surveys and to prepare suitable plans for any proposed flood control district in such drainage area, or any part thereof, in order to control, store, preserve, and regulate the flow of rivers and streams and diminish or eliminate

floods inimical to the public health and safety and destructive to public and private property and works.

When the Board has completed suitable plans, it shall adopt them as official plans and give public notice of such adoption in at least two newspapers in each county, wholly or partially within such flood control district, if so many are published therein, once a week for two consecutive weeks, which notice shall state that the official plans are on file in the office of the Board. The Board shall also give notice to all persons whose property may be taken, damaged or destroyed in the completion of such plans, by registered mail to the last known post office address of the owner or reputed owner of the property. A certified copy of the completed suitable plans shall, upon their adoption, be recorded in the office of the recorder of deeds of each county, wholly or partially within a flood control district. Such recording shall be constructive notice to all owners whose property may be taken, damaged or destroyed in the completion of such plans.

Any action in equity to restrain the Board from proceeding with the official plans for any flood control district and the establishment of such district by any party aggrieved thereby, shall be heard forthwith by the court in which such proceedings may be instituted, and any appeal or appeals shall be heard by the Supreme Court in any district in which it may be in session, as is provided in cases of appeals from special or preliminary injunctions."

Official plans shall become effective for a flood control district, and the district shall be deemed established when the Board shall have completed suitable plans and adopted them as official plans and given the notice of such adoption provided for in the statutes. (See Chapter 9: Prevention and Control of Floods, Purdon's Pennsylvania Statutes Annotated - Titles 32-34, and Act No. 18, approved March 10, 1937, PL 43, as amended.)

Soil and Water Conservation Districts: Sixty-four of Pennsylvania's 67 counties have been declared Soil and Water Conservation Districts by their respective county commissioners under the provisions of the State Soil and Water Conservation District Law, Act 217. These districts, functioning through a board of five unsalaried directors who have been appointed by the county commissioners, and working with the guidance and assistance of the State Soil and Water Conservation Commission, plan and activate a progressive natural resources conservation program for the county. The districts' objectives are to provide for the conservation of the soil; assist in the control of floods; prevent impairment of dams and reservoirs; assist in maintaining the navigability of harbors and rivers; preserve wildlife; preserve the tax base; protect public lands; and promote the health, safety, and general welfare of the people of the Commonwealth.

The districts sponsor all PL 566 watershed work plans in their areas, assisting in, and guiding, the implementation of the land treatment measures proposed in the plans.

COUNTIES, MUNICIPALITIES, AND TOWNSHIPS

Counties, municipalities, and townships may construct, operate, and maintain water supply reservoirs, treatment, and distribution systems; sewage collection and treatment systems; flood control and stream clearance projects; and park and recreation facilities, subject to approval of the Water and Power Resources Board and/or the Sanitary Water Board or the particular state agency involved, and may exercise the power of eminent domain for these purposes. Zoning powers, however, rest with the local jurisdictions rather than the Commonwealth.

CENTRALIZED VS. DECENTRALIZED RESPONSIBILITY FOR WATER MANAGEMENT FUNCTIONS

As previously stated, the Commonwealth dealt with water and related land resource problems as they materialized and the need for action became urgent. This had the effect of decentralizing activities and dividing responsibilities for water management and conservation functions among a number of agencies.

Regulatory responsibility rests primarily with the Department of Forests and Waters and the Department of Health, and their administrative boards, but several other agencies are either directly involved or have a direct interest in the Commonwealth's water resources programs. (See ADMINISTRATIVE STRUCTURE).

While some of these agencies are represented on the Sanitary Water Board and the Water and Power Resources Board, a fact which affords a measure of liaison and coordination with regard to their water programs, not all agencies are represented.

Because this fragmentation of responsibilities does present obvious problems in carrying out water programs, the Commonwealth agencies, in recent years, have found it necessary to develop close and effective coordination of their water related activities both within the Commonwealth and with their counterpart agencies in the Federal Government and adjoining states.

"HOME RULE" CONCEPT

ARTICLE III, Section 7 (Special and Local Legislation Limited) of the Constitution of Pennsylvania indicates that the General Assembly shall not pass any special or local laws regulating the affairs of cities, townships, wards, boroughs, or school districts and, in addition, lists many other areas where local or special laws may not be passed by the General Assembly.

Further, ARTICLE XV (Cities and Cities Charters) Section 1, "Home Rule" as amended, states, in part that "Cities, or cities of any particular class, may be given the right and power to frame and adopt their own charters and to exercise the powers and authority of local self-government, subject, however, to such restrictions, limitations and regulations as may be imposed by the Legislature." (See also ADMINISTRATIVE STRUCTURE - COUNTIES, MUNICIPALITIES, AND TOWNSHIPS.)

The General Assembly has enacted various codes which regulate local government in Pennsylvania. These codes in effect are the Charters for the various cities and counties in Pennsylvania. The only city with a real home rule charter in the State is Philadelphia.

FINANCING

The financial responsibility for the construction and operation of water pollution control facilities rests with the person, municipality, subdivision, or industrial establishment discharging the waste water. The producer of the waste water must be prepared to bear the cost of pollution abatement; however, in some cases, financial aid is available in the form of grants and loans for planning, construction, and operation of necessary facilities. This financial aid is administered by the Sanitary Water Board, the Department of Health and the Federal Water Pollution Control Administration.

In the case of flood control, stream clearance, and recreation projects constructed by the Commonwealth, the local jurisdiction benefiting from the project is expected to furnish lands, easements, and rights-of-way and to maintain the project after completion. Construction and operation of water supply and treatment facilities are considered to be either a local responsibility or that of public or private water supply agencies serving an area. In the case where storage for water supply is included in a state reservoir project, the benefiting local jurisdictions are expected to pay the additional cost necessary to provide such storage.

COOPERATION AND COORDINATION

Federal Programs: The Commonwealth has cooperated for many years with the Federal Government on water and related land resources programs and has coordinated the efforts of its agencies with those of the Federal Government. Examples are the cooperative programs with the U.S. Geological Survey and the Department of Forests and Waters in stream gaging, streamflow data, and compiling stream records, and the Federal-State Flood Forecasting Service, a joint, cooperative service of the U.S. Weather Bureau, U.S. Geological Survey, and the Pennsylvania Department of Forests and Waters. The federal and state governments share the cost of these programs and both state and federal personnel are utilized.

Within the past decade, however, this policy of cooperation and coordination has been re-emphasized and expanded, and even closer working relationships have been developed for the exchange of data, information, and ideas, and for the joint study and development of water projects and programs. For instance, the various major river basin study coordinating committees furnish a medium for active participation by the Commonwealth agencies in the comprehensive studies and planning for the development of water and related land resources being carried out by the federal agencies in those river basins.

Studies and plans for all federal water projects of the U.S. Army Corps of Engineers, and the U.S. Soil Conservation Service under PL 566 are reviewed by appropriate state agencies to determine whether additional purposes might be served and the project expanded to include

participation by the State agencies concerned. For example, the Fish Commission, the Game Commission, and/or the Department of Forests and Waters, after such determination, may cooperate on a cost-sharing basis with the Federal Government to develop the multiple-purpose potential of the particular project, to improve fishing, to develop wildlife and waterfowl habitat, to assure added storage for water supply, to add recreational facilities, etc. Further, the Department of Forests and Waters personnel directly assist in the planning and hydrology studies on PL 566 projects, as related to forest land.

The grant program under the provisions of the Federal Water pollution Control Act, providing federal funds for the construction of sewage and collection and treatment facilities, is administered on the state level by the Sanitary Water Board. The Department of Health's pollution control program is subsidized by, and receives research grants from the federal government.

Interstate: (See ADMINISTRATIVE STRUCTURE - INTERSTATE COMPACTS, AGENCIES, AND COMMITTEES). It is the Commonwealth's policy to cooperate fully and to share and coordinate her technical knowledge and activities with her sister states in solving mutual water and related land resources problems related to the conservation, development, management, and control on a regional or basin-wide basis.

Accordingly, as a member or signatory party to the interstate compacts and committees mentioned previously, the Commonwealth contributes financially to the support of these agencies.

Political Subdivisions: The Department of Forests and Waters cooperates with municipalities in the construction and completion of projects and improvements for the conservation of water and the control of floods. The Department has the power to use and expend any funds advanced by the municipalities for these purposes in the same manner as it expends any funds appropriated by the Commonwealth for similar purposes. It may also cooperate with the authorities of townships, boroughs, and cities of the Commonwealth in the acquisition and administration of municipal forests and may enter in cooperative agreement with county, township, municipal or private agencies for the prevention and suppression of forest fires.

In cases where the local jurisdictions are responsible for sharing in the cost of constructing works for improvement of fish and wildlife, recreation, irrigation, drainage, and for water supply for example, on U.S. Soil Conservation Service projects under PL 566), and may have difficulty in raising the necessary funds, a part of these costs may be provided through the Water and Power Resources Board. (See ADMINISTRATIVE STRUCTURE - SPECIAL PURPOSE DISTRICTS, Flood Control Districts).

The Department of Health administers yearly grants to cover the operation of public sewerage facilities. The grants are authorized

by Act 339 of the General Assembly, approved August 20, 1953, as amended, and each grant is equal to 2 percent of the construction cost of the facility involved.

Multiple-Purpose Operations: The Commonwealth subscribes to the policy of multiple-purpose planning and development of her water and related land resources.

For example, in the matter of reservoir construction, the Commonwealth has long since realized that each reservoir and each reservoir site is now a valuable resource in its own right. Good storage sites are no longer plentiful and are fast disappearing, and it has, therefore, become imperative that all future reservoir projects, large and small, be studied from the standpoint of utilizing each one with maximum efficiency and including all possible uses.

While there are still situations where single-purpose reservoirs may be utilized, and indeed, may furnish the most economical and efficient solution, reservoirs of this type, each operating independently, generally do not contribute to efficient and economical watershed management.

In keeping with this policy, the Commonwealth now participates in river basin planning and development and carefully investigates each and every federal water project in Pennsylvania to determine whether any additional purposes or uses can be added economically. For example, the Commonwealth has purchased the entire peripheral area of many of the Corps' flood control projects to develop for recreation.

Each proposed PL 566 project is reviewed, and the Commonwealth has cooperated with the U.S. Department of Agriculture, Soil Conservation Service, in adding additional purposes where needed and where the drainage area above the structure is large enough to sustain additional storage. Prime examples of this policy of cooperation and coordination on multiple-purpose planning and development are the Brandywine, Codorus, and Neshaminy Studies and Plans for the development of the water and related land resources of those basins, and which involve a number of Commonwealth agencies, their federal counterparts, and the local people and organizations. (See PROGRAMS - PLANNING, CONSTRUCTION AND DEVELOPMENT).

USE (OR NON-USE) OF EXISTING AUTHORITY

For the most part, existing authorities are exercised by the State agencies, limited only by appropriations and staffing problems.

RECENTLY ADOPTED CHANGES

On January 1, 1964, the Department of Mines and Mineral Industries assumed responsibility for investigation and enforcement connected with

the Sanitary Water Board's program for control of pollution from bituminous strip mines. The Pennsylvania Department of Health and the Allegheny County Health Department entered into an agreement in 1962 providing for the transfer of planning and review activities formerly carried out by the Department in Allegheny County.

RESEARCH, DATA COLLECTION, AND INTERPRETATION: (See Responsibilities of STATE DEPARTMENTS, AGENCIES, BOARDS, AND COMMISSIONS in the section on ADMINISTRATIVE STRUCTURE.)

The Commonwealth agencies conduct continuing programs of applied research concerned with water and related land resources, as well as data collection and interpretation. Many of these programs are carried out in cooperation with federal and local agencies. In most cases, funds for research are somewhat limited.

Among these ongoing programs are the research programs of the Department of Health on various technical problems. The Department retains consulting engineers and private research agencies to accomplish much of its applied research.

The Department of Health maintains a 176-station water quality network to collect basic information on stream quality throughout the State. Samples are collected at each station approximately every four months and are analyzed for from 20 to 24 parameters. An inventory of sewage, industrial wastes, and public water supply cases is kept by the Department and is aimed at providing an up-to-date summary of the status of compliance with the provisions of the Clean Streams Law and Sanitary Water Board orders. The inventory is maintained by using modern high speed data processing machines.

The Bureau of Topographic and Geologic Survey of the Department of Internal Affairs in Harrisburg carries out detailed laboratory and field studies on rock formation, mineral deposits, ground water resources, and topographic mapping. The Oil and Gas Division Branch Office in Pittsburgh collects detailed oil and gas data and maintains an oil and gas well sample library. A long list of detailed geologic reports is available and all projects terminate with published reports available to the public.

The Pennsylvania Fish Commission maintains a fishery research station at Benner Spring, Bellefonte, Pennsylvania, for the purpose of studying fish problems and developing proper fish management practices in the public waters of the Commonwealth. The application of modern fish cultural techniques and the prevention and control of disease are also important phases of the work accomplished at the station.

The Department of Forests and Waters' Division of Hydrography, in cooperation with the U.S. Geological Survey, operates a network of approximately 170 stream gaging stations. Its major duties are to collect records of stream stages and flows, make analyses and interpretations necessary to convert these basic data into forms needed by the operating divisions of the Department and other agencies, and undertake special hydrological studies as required.

The State Soil and Water Conservation Commission directs a State program which provides for conservation of soil and water resources. The Commission also coordinates the related conservation activities of other local, State, and federal agencies.

Conservation activities which are sponsored by the State Soil and Water Conservation Commission are put into actual practice primarily through the efforts of local soil and water conservation districts. These districts are organized on a county basis. A county may be declared a district by the County Commissioners when they have found that a substantial proportion of the county's population desires such action. The local district is governed by a group of five directors who are appointed by the County Commissioners. Sixty-four of Pennsylvania's 67 counties have been designated by their respective commissioners as Soil and Water Conservation Districts.

Conservation activities promoted by local soil and water conservation districts include the following practices: farm ponds, strip cropping, tile drainage, tree planting, diversion terraces, grassland improvement, grass waterways, and open drains.

The State Soil and Water Conservation Commission is also responsible for development of the State Program for Section 203 of the Appalachian Act (Land Stabilization and Erosion Control) and cooperates with the Pennsylvania State University and Soil Conservation Service of the U.S. Department of Agriculture in the extensive soil survey program which is being accomplished in Pennsylvania.

The Federal-State Flood Forecasting Service, which furnishes flood forecasts and warnings throughout the Susquehanna, upper Ohio, and Delaware River Basins, utilizes a network of approximately 180 river and rainfall stations in the various river basins to obtain data for their daily forecasts and for updating and developing methods and procedures for improving their forecasts. In addition, the Commonwealth operates and maintains a network of approximately 90 recording rain gages in support of the daily reporting system and for the purpose of obtaining permanent records on rainfall amounts, intensity, and duration.

Insofar as related land resources are concerned, the Bureau of State Parks and the Division of State Forest Management, Forest Protection, and Forest Advisory Service of the Department of Forests and Waters are involved in varying programs designed to preserve, protect, enhance, develop, plan, and manage the Commonwealth's forest resources, both public and private, and/or plan and develop the Commonwealth's recreational potential. Applied research on plant diseases and insect control is carried out by the Entomology and Pathology Laboratory of the Division of Forest Advisory Services. The Division of Forest Advisory Services has also been able to increase technical assistance to private woodland owners in specific programs with the cooperation of various federal agencies.

Under a program involving about 10,700,000 acres of forest land, scientific forest management assistance is given to private woodland owners. Further, scientific forest management plans are formulated and executed on 2,000,000 acres of state forest land, and about 15,000,000 seedlings are produced and shipped annually for reforestation of idle land best suited to timber production. Continued research on water and related land resources is carried out at a number of universities in the State.

The Game Commission, in order to achieve the goals as outlined by the Game Law, is divided into the Divisions of Research, Land Management, Propagation, Law Enforcement, Conservation, Information and Education, and Administration.

An active research program relating to the wildlife species common to the State provides recommendations that the Land Management Division initiates on state game lands which now total 1,013,467.9 acres. A shrub and tree nursery, operated by the Game Commission, provides necessary plant species required for most programs. The Division of Propagation operates hatcheries and game farms for wild waterfowl, pheasants, turkey, and quail. These management methods are made available to the general public by the Conservation, Information and Education Division.

PLANNING, CONSTRUCTION, AND DEVELOPMENT

As previously stated, the Commonwealth subscribes to the policy of multiple-purpose planning and development of her water and related land resources, and it is now felt that, wherever feasible, single-purpose planning and development must give way to multiple-purpose planning and development.

For example, while a purely flood control project serves a highly important purpose, and does regulate a portion of our water resources, it does not necessarily conserve water for future use. The long existing single-purpose criteria, then, can no longer be accepted as the rule. In addition, the conservation and development of water resources must be coordinated with the conservation of soil, forests, wildlife, minerals, and others.

While the Commonwealth presently has an abundant supply of raw water, this fact alone will not, as in the past, assure adequate supplies of good water to meet all future demands and uses. Indeed, good water is even now not always available in sufficient quantity and quality at the time and place it is required for use.

Lack of regulation, control, and good storage sites; the toll of stream pollution; the high cost of land; cost of relocating existing highways, utilities, homes, and businesses located in storage sites; distribution problems; and many other factors involved in the complexity

of modern day living, all contribute in making these seemingly abundant supplies totally inadequate for the future.

Because so many federal, state, and local agencies are involved in the many phases of planning and development of the Commonwealth's water and related land resources; and because so many local, State and national organizations also have interests involving those resources; the Commonwealth has long since recognized the fact that no really effective plan can be developed and implemented without the full cooperation of all concerned. Further, coordination of all their activities and efforts is essential if our programs, designed to supply adequate supplies of good water for all future uses, are to be successful.

Accordingly, a close and excellent working relationship between the Commonwealth agencies with their counterparts in the Federal Government, in adjoining states, and with local jurisdictions and interested organizations, has been developed.

Thus far, nine comprehensive studies of the water and related land resources of Pennsylvania's river basins are underway, or have been completed, along with recommended plans for the progressive development of those resources to meet present and future needs.

The first five cover the Commonwealth's major river basins - the Delaware, the Potomac, the Susquehanna, the upper Ohio, and Lake Erie. The sixth covers a small area in the Genesee River Basin which flows north into New York. These basin studies and plans, when completed, will cover the entire state, and are being carried out by the federal agencies with the cooperation of the states involved.

Some of the projects originally proposed in the Corps' Delaware Plan, and now contained in the comprehensive plan of the Delaware River Basin Commission, are currently underway and nearing construction. In addition to those proposed for federal construction, certain of the projects proposed for development below the federal level are presently under acquisition or design by the Commonwealth.

The Commonwealth has also completed three equally comprehensive studies and plans for the Brandywine Creek Basin in Chester County, the Codorus Creek Basin in York County, and the Neshaminy Creek Basin in Bucks and Montgomery Counties.

These studies and plans are designed to meet the needs of local areas, not covered in the broader, overall plans of the federal agencies, and involve the same time period as the major studies.

The Brandywine Study and Plan, which provides for the progressive development of the water and related land resources of the Brandywine Creek Basin in Pennsylvania, was completed in cooperation with the U.S. Department of Agriculture, Soil Conservation Service, under PL 566, and the local people.

The Codorus Plan was a cooperative effort of the Commonwealth and the local people. The Soil Conservation Service was not involved because the basin has few, if any, flood problems.

Units or individual projects proposed in both of these plans are nearing the construction stage.

The Neshaminy Study was a cooperative effort by the Department of Forests and Waters, the U.S. Department of Agriculture, Soil Conservation Service, the Pennsylvania Department of Health, and the local people.

Flood Control: The Department of Forests and Waters constructs flood control works of various kinds along these streams where damage has, or is likely to occur, and where the damage and/or danger to life and property is sufficient to justify the cost of a project. This protection consists of stream clearance, channel improvement, levees, and flood walls.

The Commonwealth's flood control program is generally designed to supplement and fill the void by the federal and local programs of this nature. For example, since 1955, the Department has completed over 400 stream clearance projects and 65 flood control projects costing in excess of $30,000,000. The Department has, however, constructed a number of multiple-purpose reservoirs, some of which were constructed with flood control as a primary purpose.

The Soil and Water Conservation District Law, Act 217 authorizes the State Soil and Water Conservation Commission to approve applications and recommend priorities for watershed planning under the PL 566 Watershed Protection and Flood Prevention Act of 1954, as amended. Eighty applications have been received and acted upon to date. The State Soil and Water Conservation Commission also reviews and secures comments from involved State agencies for submission to Washington by the Governor. Soil and water conservation districts are required as co-sponsors of all PL 566 projects in Pennsylvania and assume the responsibility of the land treatment phase of approved work plans.

The State Soil and Water Conservation Commission through soil and water conservation districts is also responsible for a statewide soil and water conservation program which involves water storage for agricultural use including water for livestock, crop spraying, irrigation, and domestic use. A total of 7,631 water impounding structures have been built on district cooperators farms as of January 1, 1966.

Water Supply and Hydro-Power: Construction of water supply reservoirs, development of water supply sources, and distribution of water is generally considered to be a local responsibility or that of public or private agencies or companies serving a particular area.

Planning and coordination for municipal systems is encouraged by the Department of Community Affairs.

They are, however, closely regulated by the Department of Health and the Water and Power Resources Board.

The Secretary of Health issues permits for the construction and operation of public water supplies. The Department of Health reviews the public health aspects of a proposed water supply project and, if the project is satisfactory, a permit to construct is issued. The Department has no legal responsibility for promoting new construction and development but has carried out a program in this area.

The Water and Power Resources Board approves letters patent for incorporation of water and water power companies, and issues permits for allocations to public water supply agencies for public water supplies from surface sources.

The Board also issues limited power and limited water supply permits for the construction of power and water supply dams and appurtenant works. While the Board may issue a permit for the construction of a water supply, or other dam under the Encroachment Act, this action does not confer the power of eminent domain. On the other hand, limited power and water supply permits do confer this power.

The Commonwealth includes water supply storage in its reservoir projects upon request of the local people, provided that they agree to pay for that portion of the structure needed to provide the water supply.

With regard to those federal multiple-purpose projects which include downstream water supply to be provided by low-flow augmentation, the Commonwealth may furnish the Federal Government with the local assurances for repayment for the cost of providing the necessary storage when the benefits are widespread.

Water Quality Control: The Sanitary Water Board issues orders requiring the abatement of stream pollution. The orders specify that the discharge be abated or that satisfactory treatment of the waste water be provided. The construction of a treatment facility is the alternate normally accepted. Planning and coordination for municipal sewers is encouraged by the Department of Health and the Department of Community Affairs.

Navigation: The regulation of motor boats operated or navigated upon any public stream, artificial, or natural body of water, or non-tidal waters of any river within the Commonwealth is under the jurisdiction of the Pennsylvania Fish Commission and its Advisory Board for Boating. The Fish Commission prescribes, promulgates, and enforces general rules and regulations regarding navigation or operation of motor boats deemed necessary for the public health and safety of persons or

property on or in such waters, or for the preservation of all forms of useful aquatic wildlife, particularly as to speed, lights, signals, courses, channels, rights-of-way, and the disposal of oil, gas, gasoline, or other wastes from such boats. Among other items covered are the compilation of statistics on, and reporting of, boating accidents, safety equipment, and governing operation of vessels, including water skiing, the issuance of permits for races, regattas, and marine parades.

All motor boats must be registered, and such registration is carried out through the Department of Revenue. The Fish Commission does not have jurisdiction in the Delaware River and its navigable tributaries, however, the Navigation Commission for the Delaware River has concurrent powers. While other craft are not generally regulated, safety measures and regulations are imposed on such craft on state-owned recreational lakes, and the use of motors may be barred or regulated as to horsepower.

The Navigation Commission for the Delaware River and its navigable tributaries, a departmental commission of the Department of Forests and Waters, has regulatory authority in that area, licensing pilots, and regulating and issuing permits for wharves, piers, and other harbor structures. The Commission is also authorized to set maximum rates for wharfage, cranage, and dockage.

General Recreation: Over ten years ago, the Department of Forests and Waters embarked on a program to update and strengthen the state park system using the slogan "A park within 25 miles of every Pennsylvanian." We have come close to achieving that goal, and today, our state park system is the third most heavily-used in the Nation. Since 1955, the number of state parks has increased from 54 to 64. In addition, there are six state historical parks, 45 state forest picnic areas, two state forest monuments, seven state natural areas, and one state vista. Added to these are Pymatuning Park and Reservoir, and four commissioned parks, Valley Forge, Washington Crossing, Brandywine Battlefield, and Presque Isle. Currently, the Department has under design or construction ten new state parks, six new state park areas acquired for later development and eight state parks under land acquisition. In recognition of the importance of water-based recreation, the new parks, for the most part, are based either on reservoirs or reservoirs have been constructed as the heart of the park. This program is now close to completion.

The enabling act for PROJECT 70, a statewide land acquisition program to provide the necessary land for parks, reservoirs, and other conservation, recreation, and historical preservation purposes, was signed by the Governor, June 22, 1964.

Because of a constitutional debt limitation (Article IX, Section 4), this $70,000,000 bond issue required a constitutional amendment, which was approved by vote of the people in 1963.

Under this program $40,000,000 was allocated to the Department of Forests and Waters for acquisition of land for regional parks and reservoirs in 43 critical urban counties. Twenty million dollars was allocated

for matching grant to any regional, county, or municipal authority for local park, recreation, and open space acquisition purposes. This part of the program is administered by the Pennsylvania Department of Community Affairs. The remaining $10,000,000 was split equally between the Pennsylvania Fish and Game Commissions for acquisition of important fish, wildlife, or boating areas threatened by impending private development. A number of reservoir sites and many of the park sites, mentioned previously, are presently under acquisition as a part of this program which is to be completed by 1970.

Currently being considered is a $500,000,000 bond issue to be called the Land and Water Reclamation Fund, part of which is to be used for development of the sites acquired under PROJECT 70.

Fish and Wildlife: The Pennsylvania Fish Commission constructs dams to impound water for fishing lakes, while the Pennsylvania Game Commission impounds water for waterfowl management. Both agencies work closely with the U.S. Department of Agriculture, Soil Conservation Service, and sponsor PL 566 projects when such projects may be expanded to provide fish and wildlife pools. In addition, both agencies actively participate, where feasible, in enhancing the fish and wildlife potential of other State and federal projects. Restocking, where required, is a part of the fish and wildlife programs, as is the improvement of habitat.

REGULATION: (See also STATE LAW and POLICY sections.)

Water Use: While the Water and Power Resources Board is empowered to allocate water from surface sources to public water supply agencies, this actually affects only about eight percent of the Commonwealth's surface waters, and the statute carries no penalty for violation. There are no statutes regulating subsurface waters. Some further measures of control on use of surface waters is possible, however, through application of the provisions of the Encroachment Act to intake and outfall structures, and on use of underground waters, through the fact that the quality of all water to be used for public consumption must be approved by the health agencies.

Water Quality: The Sanitary Water Board regulates stream water quality by regulating the amount and type of domestic or industrial wastes entering the waters of the State. (See also Water Use.)

One of the most serious water quality problems is caused from acid-mine discharges from abandoned coal mines. The Sanitary Water Board's acid-mine drainage program has largely succeeded in preventing pollution of clean streams from active mines. The control of pollution from abandoned mines has not yet been accomplished.

Construction by Political Subdivisions and Private Interests: Construction of water impoundments and encroachments by political subdivisions and private interests is regulated by the Water and Power

Resources Board. The Sanitary Water Board regulates the construction of all waste treatment facilities from which there is a discharge into the waters of the Commonwealth, but construction adequacy and safety of the facilities is not within the authority of the Board.

Well Drilling: The Department of Internal Affairs has jurisdiction over the licensing of water well drillers, and well drillers are required to keep logs.

Use of Flood Plains: The Commonwealth has a guiding interest in the preventative control, i.e., flood plain zoning. Zoning powers, however, are in the hands of the local governments in Pennsylvania.

The Department of Forests and Waters, in cooperation with the U.S. Geological Survey, produced a manual, based on hydrologic principles, for the use of interested local communities in establishing zones or areas subject to flooding. (U.S. Geological Survey Water Supply Paper 1526, Hydraulic and Hydrologic Aspects of Flood Plain Planning, 1961.)

Drainage, Irrigation, and Control of Erosion and Sedimentation: While there is no regulatory authority concerning these items, the programs of the Department of Agriculture and the State Soil and Water Conservation Commission, working in cooperation with the farmers, the soil and water conservation districts and the U.S. Department of Agriculture, Soil Conservation Service, are geared to meet these problems on a scientific basis and to furnish technical information as required.

Reservoir Sites: (See also PROGRAMS section, PLANNING, CONSTRUCTION AND DEVELOPMENT - General Recreation.)

Under the PROJECT 70 program, the Commonwealth may acquire land for reservoir sites for later development. Under ordinary circumstances, however, land is acquired just prior to construction of the project.

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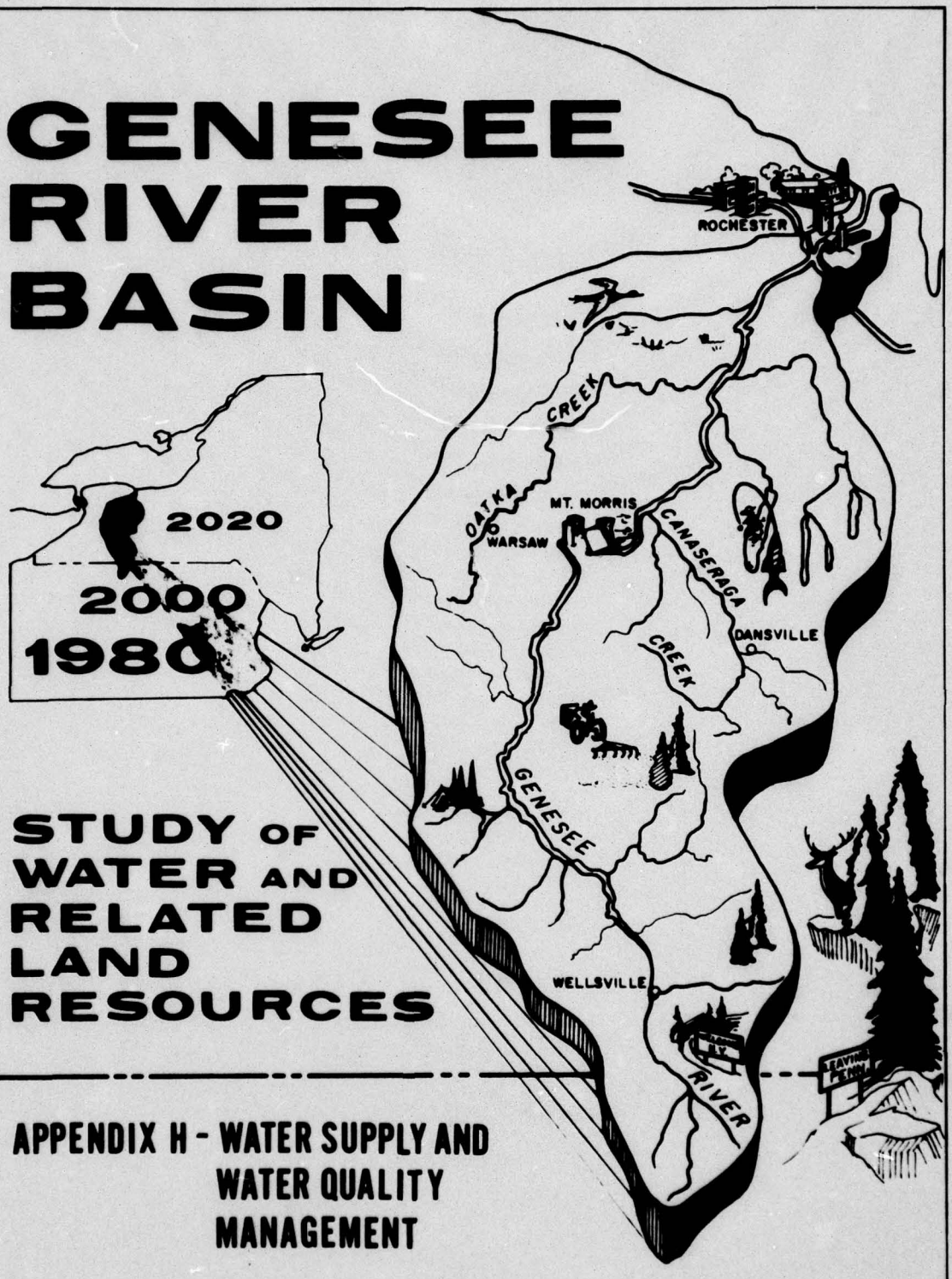

STUDY OF WATER AND RELATED LAND RESOURCES

APPENDIX H - WATER SUPPLY AND WATER QUALITY MANAGEMENT

GENESEE RIVER BASIN

COMPREHENSIVE STUDY

OF

WATER AND RELATED LAND RESOURCES

APPENDIX H

WATER SUPPLY

AND

WATER QUALITY MANAGEMENT

Genesee River Basin Study

Task Group No. 4

WATER SUPPLY AND WATER QUALITY MANAGEMENT

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ENVIRONMENTAL HEALTH SERVICES

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DIVISION OF PURE WATERS
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ASSISTANT COMMISSIONER

January 31, 1967

Colonel R. Wilson Neff
District Engineer and Chairman
Genesee River Basin Study
Coordinating Committee
Buffalo District, Corps of Engineers
Foot of Bridge Street
Buffalo, New York 14207

Dear Colonel Neff:

Transmitted herein is a draft of "Water Supply and Water Quality Management," Appendix H of the Comprehensive Genesee River Basin Study.

The Federal Water Pollution Control Administration report "Genesee River Basin Water Pollution Control Program" represents a cooperative State-Federal study effort and was utilized for much of the material reported herein on water quality and pollution control. This report is one in a series of program reports for the watersheds within the Lake Ontario Drainage Area which will be published by the FWPCA in the spring of 1967. Copies will be made available at that time as an attachment to this appendix.

Copies of the "Official Classification of the Genesee River Drainage Basin" are available from the New York State Department of Health. A public hearing has been scheduled by the State Water Resources Commission to consider upgrading the lower Genesee River.

Appendix J - Agriculture and upper Watershed Development - prepared by the United States Department of Agriculture contains estimates of the use and needs of rural areas served mainly from individually owned wells, springs and ponds.

The United States Geological Survey prepared the following reports:

(1) "Time-of-Travel Studies, Genesee River Basin"; this document may be inspected at the Survey's Albany or Washington offices.

(2) "Duration, Frequency and Distribution of Stream Flow in the Genesee River Basin with Emphasis on Low Flows"; this document is made an attachment to this appendix.

(3) "Ground Water Resources"; this document is Appendix I of the Comprehensive River Study.

Respectfully submitted,

Irving Grossman
Chairman, Task Group #4
Comprehensive Genesee
River Basin Study

CONCLUSIONS AND RECOMMENDATIONS

A. Water Supply

1. Rochester Metropolitan Area:

Lake Ontario is the most logical source of water supply for the Rochester Metropolitan Area. The supply is unlimited, the quality can be made excellent by modern treatment and the supply can be developed in stages.

The present raw water quality must be maintained and improved by requiring a minimum of secondary treatment and chlorination for all municipal and industrial waste discharged to the lake.

Water supply sources are adequate to meet present demands and a program of expansion is in progress to meet future demands.

2. Central Plains Area:

The Central Plains Area is blessed with natural lakes. Redistribution of the water produced from Canadice and Hemlock Lakes plus the efficient development of the Honeoye and Conesus Lake watersheds would be capable of supplying the elevated areas of Monroe County and the Central Plains Area for the period considered in this report. The available satisfactory raw water subjected to minimum treatment consisting of coagulation, filtration and chlorination will provide an esthetic safe public water supply.

An alternative for supplying water to this area would be a reservoir on the Genesee River south of Mt. Morris. A 25 MGD source plus the existing supplies would be adequate for the area through the year 2020.

3. Allegany Plateau:

The present and future demands for water in the Allegany Plateau are relatively small. Efficient development of the available ground water and small watershed development is recommended to meet these requirements.

B. Water Quality Management

1. All municipal waste treatment facilities should be designed and operated

to provide secondary treatment and continuous chlorination for disinfection. This is the policy of the New York State Department of Health.

2. Reduction in nutrients, especially phosphates, through modification in the operation and/or design of existing and newly constructed secondary waste treatment facilities is necessary.

3. Combined sewers should be prohibited in all newly developed urban areas and should be separated in coordination with urban renewal projects. Existing combined sewer systems must be maintained properly and overflow regulating devices adequately adjusted to convey the maximum practicable amount of combined flow to treatment facilities, especially in the Rochester Metropolitan Area.

4. All separately discharged industrial wastes should receive the equivalent of secondary treatment. Where practicable, industrial wastes should be discharged to municipal sewerage systems and such pretreatment provided to remove gross solids, toxic materials, or to reduce excessive organic loadings to minimize the burden imposed on municipal treatment facilities. Sanitary sewage discharged from industries should receive the same treatment as recommended for municipal wastes.

5. Secondary treatment will be inadequate for a number of waste treatment plants presently located on critical sectors of the tributaries and main stem of the Genesee River. Advance treatment, exclusion, and low flow regulations are alternatives to be considered in meeting water quality standards in these sectors. Economic consideration of the alternatives independently tends to favor advanced waste treatment or exclusion at all locations. However, the plan formulation phase of the study currently under way to consider the multipurpose benefits of impounded water may justify a combination of the alternatives including low flow regulation as the most

feasible plan to satisfy water quality standards. The Corps of Engineers should ascertain with the Federal Water Pollution Control Administration the value of benefits related to water quality control in multipurpose projects.

6. An adequate water quality monitoring program should be administered to indicate the trends in water quality and the need for additional quality improvement measures. The New York State Department of Health has instituted a program consisting of seven stations in the basin.

7. Master plans for future waste collection and treatment facilities should be developed for the rapidly expanding metropolitan areas. Such plans provide, among other things, for maximum use of facilties which will permit eventual elimination of the conglomeration of small, inefficient facilities surrounded by residential and commercial development. Comprehensive sewerage studies administered by the State Department of Health are under way or planned for each of the following counties within the basin: Monroe, Livingston, Steuben, Allegany, Ontario, Genesee, Wyoming. These studies should be completed by January 1969.

CHAPTER I

INTRODUCTION

A. Purpose and Objectives of Task Group #4

The Corps of Engineers were authorized by resolution adopted February 1, 1962 by the Committee on Public Works of the United States Senate to initiate a comprehensive multi-purpose study of the water resources of the Genesee River Basin. This action was recommended by the Temporary State Commission on Water Resources Planning, an organization created by the Water Resources Law passed by the New York State Legislature in 1959. This commission designated the Genesee River Basin as the site for a proposed pilot water resources planning and development project within the concept of the new multi-purpose, multi-interest approach to the water resources problems of a drainage basin as proposed by the new Water Resources Law. This study included a request to reevaluate Mount Morris Dam, a single purpose flood control structure on the Genesee River, as to the feasibility and the desirability of converting this installation into a framework that would meet the need of the water users within the basin on a much broader basis.

The Genesee River Basin coordinating committee issued a Plan of Survey for a comprehensive basin plan for development of related water and land resources in August 1964. This committee is chaired by the District Engineer, Corps of Engineers, Buffalo, New York and is made up of one member each from the Department of Interior, the Department of Agriculture, Department of Commerce, Department of Health, Education, and Welfare, Federal Power Commission, New York State and Pennsylvania. The purpose of this committee as outlined in the Plan of Survey is to "provide an organi-

zation for full and continuing exchanges of views during the study; advise and assist all participating agencies with regard to objectives, work assignments, and schedules; assist in the resolution of study problems as they arise; and make periodic review of progress."

The Plan of Survey divides the efforts and responsibilities of all participating federal, state, and local agencies into 13 task groups. "Ground Water and Quality of Water Studies" has been designated as Task Group #4 in the Plan of Survey.

A committee meeting of Task Group #4 held on March 10, 1964 reviewed the project and outlined the various responsibilities into a program that would be carried out by each of the participating agencies. The general work plan for the task group detailing responsibilities is outlined in Table I-1.

The Plan of Survey requests that all participating agencies terminate their activities on any scheme when it becomes apparent that the improvement cannot be justified. The Plan of Survey also establishes the following guidelines:

(1) identify the general nature and scope of water resource development needs which will be encountered in the years 1980 and 2020 but confining planning studies to the minimum detail and scope necessary to meet these requirements;

(2) define and evaluate in sufficient detail to comprise a basis for authorization only those projects for which federal authorization will be required to permit necessary construction to be initiated in the next ten to fifteen years; and

(3) identify the general nature and scope of the parts of the plan which should be undertaken either under non-federal or federal programs

Table I-1
GENESEE RIVER BASIN COMPREHENSIVE STUDY
Task No. 4
GROUND WATER AND QUALITY OF WATER STUDIES

WORK PLAN

Activity	Objective and Purpose	Cooperating Agency
1. Inventory of Present Water Use	Tabulate existing data pertaining to major water supply and uses including analytical records of water* and wastewater quality	State Health Department ** U.S. Public Health Service U.S. Geological Survey Soil Conservation Service
2. Flow Measurements Including Time of Travel Studies	Determine flow characteristics and base stream flow to provide data on available water and travel time during critical periods.	U.S. Geological Survey** State Health Department U.S. Public Health Service State Conservation Department Soil Conservation Service
3. Water Quality Including Monitoring Stations	Determine quality of surface and ground water and character of waste-water discharges to evaluate impact upon water quality and potential need for low flow augmentation and treatment.	State Health Department** U.S. Public Health Service U.S. Geological Survey State Conservation Department
4. Sediment Study***	Determine whether natural soil erosion represents a problem and, if so, the extent of such problem to evaluate potential effect upon reservoir storage, stream flow and water quality.	U.S. Geological Survey** U.S. Public Health Service Soil Conservation Service Corps of Engineers State Health Department State Dept. Public Works State Conservation Department
5. Future Water Quality Management Needs	Determine the desired quality and quantity of water for potential low-flow augmentation and waste treatment needs based upon major water uses as evolved by all cooperating agencies.	All agencies on coordinating committee U.S. Public Health Service**

* Includes ground water
** Responsible Agency
*** Editor's note: For further information, refer to Task No. 6, "Sedimentation".

Table I-1 (Continued)
GENESEE RIVER BASIN COMPREHENSIVE STUDY
Task No. 4
GROUND WATER AND QUALITY OF WATER STUDIES

WORK PLAN

Activity	Objective and Purpose	Cooperating Agency
6. Ground Water Resources*	Determine general geology of basic and potential sources of ground water supplies to complete total information regarding basin's water resources; data will also be used to classify ground waters as required by State Water Pollution Control Law.	U.S. Geological Survey** State Health Department Soil Conservation Service
7. Waste Assimilation Capacity	Determine by mathematical analyses surface water capacity to assimilate present and future treated wastewater discharges to comply with water quality standards applying to official classifications for surface waters within the basin.	State Health Department** U.S. Public Health Service U.S. Geological Survey
8. Storage for Water Quality Management	Evaluate needs, if any, of municipal and industrial water supplies and/or water quality storage in existing and proposed reservoirs.	U.S. Public Health Service** Corps of Engineers Soil Conservation Service

* Ground water and compilation of analytical data to be accomplished under Activity No. 1

** Responsible Agency

Note: Responsibilities of the U.S. Public Health Service, Department of Health, Education and Welfare, were transferred May 10, 1966 to the Federal Water Pollution Control Administration, U.S. Department of the Interior.

to supplement or utilize the projects for which authorization is sought, limiting study details to the minimum necessary to insure that proper balance has been achieved between the two types of projects.

B. Past Studies

The Genesee River Basin has had frequent studies and reports made during the past 60 years. One of the most recent reports on water quality has been the report issued by the New England-New York Interagency Committee organized by direction of the President of the United States. This survey was conducted in 1950 and the results were issued in a report entitled "N. E.N.Y.I.A.C. - Part 33-34 - Genesee River Basin".

The former New York State Water Pollution Control Board published Survey Reports #1 and #2 entitled the "Upper" and "Lower Genesee River Drainage Basin", in 1955 and 1961 respectively. These reports recommended classification and assigned standards of quality and purity for various reaches of the tributaries and main stem of the Genesee River. A summary of the classification system and the water quality standards for each classification is shown on Tables I-2 and I-3. Copies of the official classification, "Upper" and "Lower Genesee River Drainage Basin" assigned and adopted by the New York State Water Resources Commission can be obtained from the New York State Department of Health.

A report published in House Document 615 - 78th Congress, second session, served as a basis for the authorization of a dam and reservoir on the Genesee River at Mount Morris, New York, to provide flood protection downstream from this site. This dam was constructed and put into operation in 1951. A list of the studies prepared for the Genesee River Basin is included in Table I-4, as an appendix to this report.

Table I-2
CLASSIFICATION STANDARDS

NEW YORK'S WATERS

CLASS	BEST WATER USE
AA (1)	DRINKING (Chlorination Required)
A (1)	DRINKING (Filtration and Chlorination Required)
B	BATHING
C (2)	FISHING
D	INDUSTRIAL
	AGRICULTURE AND DRAINAGE

Note No. 1: In determining the safety or suitability of waters in this class for use as a source of water supply for drinking, culinary or food processing purposes after approved treatment, the standards specified in the latest edition of "Public Health Service Drinking Water Standards" published by the United States Public Health Service will be used as a guide.

Note No. 2: With reference to certain toxic substances as affecting fish life, the establishment of any single numerical standard for waters of New York State would be too restrictive. There are many waters, which because of poor buffering capacity and composition, will require special study to determine safe concentrations of toxic substances.

However, based on non-trout waters of approximately median alkalinity (80 p.p.m.) or above for the state, in which groups most of the waters near industrial areas in this state will fall, and without considering increased or decreased toxicity from possible combinations, the following may be considered as safe stream concentrations for certain substances to comply with the above standard for this type of water. Waters of lower alkalinity must be specially considered since the toxic effect of most pollutants will be greatly increased.

Ammonia or Ammonium compounds:	Not greater than 2.0 parts per million (NH_3) at pH of 8.0 or above
Cyanide:	Not greater than 0.1 part per million (CN)
Ferro-or Ferricyanide:	Not greater than 0.4 parts per million ($Fe(CN)6$)
Copper:	Not greater than 0.2 parts per million (Cu)
Zinc:	Not greater than 0.3 parts per million (Zn)
Cadmium:	Not greater than 0.3 parts per million (Cd)

Table I-3

NEW YORK STATE WATER RESOURCES COMMISSION
FRESH SURFACE WATERS - CLASSES AND QUALITY STANDARDS **
(REVISED AND ADOPTED _____)

Water Use Classes	Best Use	Dissolved Oxygen m/g/l	Coliform Bacteria * Per 100 ML (Geometric Mean)	Ph	STANDARDS OF QUALITY Toxic Wastes, Deleterous Substances, Colored or Other Wastes or Heated Liquids	Floating solids; settleable solids; oil; sludge deposits; tastes or odor producing substances.	Remarks
Class AA	Source of Water Supply or Food Processing	5.0 or Greater (Trout) 4.0 or Greater (Non-Trout)	Average not to exceed 50	6.5-8.5	None in sufficient amounts or at such temperatures as to be injurious to fish life or make the waters unsafe or unsuitable. (Note 1 and 2)	None attributable to sewage, industrial wastes or other wastes	All effluents must be effectively disinfected
Class A	Source of Water Supply or Food Processing	5.0 or Greater (Trout) 4.0 or Greater (Non-Trout)	Average not to exceed 5,000	6.5-8.5	None in sufficient amounts or at such temperatures as to be injurious to fish life or make the waters unsafe or unsuitable. (Note 1 and 2)	None which are readily visible and attributable to sewage, industrial wastes or other wastes	Phenolic compounds must not exceed 5 Parts per Billion No oder producing substances to cause an increased threshold oder number greater than 8 in receiving waters All effluents must be effectively disinfected
Class B	Bathing and any other usages excent water supply	5.0 or Greater (Trout) 4.0 or Greater (Non-Trout)	Average not to exceed 2,400	6.5-8.5	None in sufficient amounts or at such temperatures as to be injurious to fish life or make the waters unsafe or unsuitable. (Note 2)	None which are readily visible and attributable to sewage, industrial wastes or other wastes	All effluents must be effectively disinfected
Class C	Fishing and any other usages excent for Bathing	5.0 or Greater (Trout) 4.0 or Greater (Non-Trout)	Not Applicable	6.5-8.5	None in sufficient amounts or at such temperatures as to be injurious to fish life or impair the waters for any other best usage. (Note 2)	None which are readily visible and attributable to sewage, industrial wastes or other wastes	
Class D	Agricultural, industrial cooling or process water	3.0 or Greater	Not Applicable	6.0-9.5	None in sufficient amounts or at such temperatures as to prevent fish survival or impair the waters for agricultural purposes or any other best usage.	None which are readily visible and attributable to sewage, industrial wastes or other wastes.	

Note No. 1: In determining the safety or suitability of waters in this class for use as a source of water supply for drinking, culinary or food processing purposes after approved treatment, the standards specified in the latest edition of "Public Health Service Drinking Water Standards" published by the United States Public Health Service. apply.

Note No. 2: With reference to certain toxic substances as affecting fish life, the establishment of any single numerical standard for waters of New York State would be too restrictive. There are many waters, which because of poor buffering capacity and composition, will require special study to determine safe concentrations of toxic substances.
However, based on non-trout waters of approximately median alkalinity (80 p.p.m.) or above for the state, in which groups most of the waters near industrial areas in this state will fall, and without considering increased or decreased toxicity from possible combinations, the following may be considered as safe stream concentrations for certain substances to comply with the above standard for this type of water. Waters of lower alkalinity must be specially considered since the toxic effect of most pollutants will be greatly increased.

Cadmium	Not greater than 0.3 parts per million (Cd)
Ammonia or Ammonium compounds	Not greater than 2.0 parts per million (NH_3) at pH of 8.0 or above
Cyanide	Not greater than 0.1 part per million (CN)
Ferro-or Ferricyanide	Not greater than 0.4 parts per million ($Fe(CN)_6$)
Copper	Not greater than 0.2 parts per million (Cu)
Zinc	Not greater than 0.3 parts per million (Zn)

* Mandated by Subdivision 5 Section 1205 of the Public Health Law

** Standards apply to low stream flows equal to or exceeding a Minimum Average 7 Day Consecutive Flow occuring once in Fifty years.

C. Task #4 Agencies and Assignments

The New York State Department of Health was designated as the responsible agency to coordinate the activities of Task Group #4. The participating and cooperating agencies designated to assist the Department in carrying out the activities of Task Group #4 are the U.S. Soil Conservation Service, the U.S. Geological Survey, the U.S. Public Health Service, the U.S. Forest Service, the U.S. Corps of Engineers, and the New York State Department of Conservation. Work plans outlining the task and responsibilities were submitted by the State Department of Health, the Public Health Service, the Geological Survey, and the Soil Conservation Service.

The Department of Health water pollution mobile laboratory was located at the Village of Geneseo sewage treatment plant during the summers of 1964 and 1965 to provide laboratory services for the survey. These laboratory services were supplemented by the Department's Central Office laboratory in Albany which performed specialized chemical analyses that could not be done in the mobile laboratory. Several samples of ground waters were collected by the Geological Survey and sent to Albany for radiological analysis. Pesticide samples were determined on surface and ground waters by the Syracuse University Research Corporation, under a contract with the Department of Health.

The Geological Survey established a field office in Perry to conduct stream flow, sedimentation and ground water studies. The time of travel studies by the Geological Survey in 1965 were conducted by personnel from the Albany District Office. The Survey's water quality laboratory in Albany performed a number of analyses on ground water and surface water samples collected during 1964 and 1965 to supplement the work done in the field by

the laboratories of the State Department of Health and Public Health Service.

The work and responsibilities of the Public Health Service, Department of Health, Education, and Welfare, has been transferred to the Federal Water Pollution Control Administration, United States Department of the Interior. The Lake Ontario Program Office in Rochester is an integral part of the Great Lakes-Illinois River Basin Project with headquarters in Chicago. The Program Office is charged with the responsibility of developing a comprehensive water pollution control program for the Lake Ontario Watershed. Justification for participation in the Comprehensive Genesee Basin Study is in accordance with the "Memorandum of Agreement" dated November 4, 1958 between the Department of the Army and the Department of Health, Education and Welfare relative to Title III of PL 500, 85th Congress, as amended by PL 87-88. The water quality portion of the study is being made under the authority contained in the Federal Water Pollution Control Act, Public Law 660, 84th Congress, as amended by Public Law 87-88.

1. Inventory of Present Water Use

Physical data on the public water supplies within the Genesee River Drainage Basin listed on the records of the New York State Department of Health have been recorded on individual cards and summarized. This summary tabulates the name and classification of the community, the county in which it is located, source of water, whether it be surface or ground, the type of treatment, and other information pertinent to the system.

A survey to determine industrial water use for disposal practice was undertaken during 1964-1965. Contact was made with industries

within the basin to update information on water use and the information recorded on Industrial Water Use and Waste Water Disposal Practices Survey - Form San. 117, prepared by the State Department of Health.

2. Flow Characteristics, Including Time of Travel Studies

The United States Geological Survey to meet the requirements of the agencies participating in the study compiled and analyzed data on stream flows in the Genesee River Basin.

Emphasis was placed on investigation of low stream flows because of its importance in evaluating pollution loads and their effects on water quality. Three types of surface water data collection sites have been established in the Genesee River Basin.

They are:

(1) gauging stations - particular sites on a stream, lake or reservoir where systematic observations of gauge height or discharge are obtained, usually on a daily or continuous basis,

(2) partial record stations - particular sites where limited or selected streamflow data are collected over a period of years for use in hydrological analyses. These include stations for investigation of both peak stages and low flow.

(3) miscellaneous sites - particular sites where streamflow data are collected on a periodic (or sometimes "one-shot") basis for a special purpose, usually low flow analyses.

The U.S. Geological Survey maintained 15 existing gauging stations within the basin and established eight new stream-discharge stations

to supplement data collection for the purpose of this study. Water temperature recorders were installed at the station on Canaseraga Creek near Canaseraga and Van Campen Creek at Friendship. Approximately 75 additional sites were selected at which low flow discharges were measured to broaden the coverage afforded by the gauging stations. Base flow (that stream flow which is derived from ground water discharge or as release from surface storage, but not from direct runoff) was measured or observed at many sites, under nearly constant conditions, to provide data for studies of stream pollution and the evaluation of basin-wide distribution of flow. Table I-5 in the appendix lists all gauging stations, partial-record stations and miscellaneous measuring sites in the basin. The sites are listed in the standard downstream order as used by the Geological Survey in the publication of streamflow data.

To facilitate identification of the basic data, station numbers as used in the annual series of the Geological Survey water supply papers and open file reports entitled "Surface Water Records of New York", are listed in Table I-5. These numbers do not indicate a distinction among station types: therefore, the type of data collected at each site is shown in a separate column. Table I-6 has been provided to indicate the respective periods of operation for all active or discontinued gauging stations in the basin.

Time of travel of water in a stream is a vital factor in determining the ability of the stream to stabilize organic wastes that have been discharged into it. Reaches of the stream that had a high waste load being discharged to them, as indicated by high BOD and low dissolved oxygen con-

Table I-6

Length of gaging-station records in the Genesee River basin
(stations listed in downstream order)

Legend

Streamflow Stage (or volume)

Period of record (1910, 1920, 1930, 1940, 1950, 1960)	Gaging station	Station number
	Dyke Creek near Andover	4-2204.7
	Dyke Creek at Wellsville	4-2205
	Genesee River at Wellsville	4-2210
	Genesee River at Scio	4-2215
	Van Campen Creek at Friendship	4-2216
	Angelica Creek at Transit Bridge	4-2217.2
	Genesee River at Belfast	4-2218.2
	Caneadea Creek at Caneadea	4-2220
	Lost Nation Brook near Centerville	4-2225
	East Koy Creek at East Koy	4-2229
	Genesee River at Portageville	4-2230
	Genesee River at St. Helena	4-2235
	Mt. Morris Reservoir near Mt. Morris	4-2240
	Genesee River at Mt. Morris	4-2245
	Canaseraga Creek near Canaseraga	4-2246.5
	Canaseraga Creek near Dansville	4-2250
	Canaseraga Creek at Groveland	4-2255
	Keshequa Creek at Graig Colony, Sonyea	4-2260
	Keshequa Creek near Sonyea	4-2265
	Canaseraga Creek at Shakers Crossing	4-2270
	Genesee River at Jones Bridge near Mt. Morris	4-2275
	Conesus Lake near Lakeville	4-2279.8
	Conesus Creek near Lakeville	4-2280
	Genesee River at Avon	4-2285
	Honeoye Lake near Honeoye	4-2288.45
	Springwater Creek at Springwater	4-2289
	Canadice Lake near Hemlock	4-2289.5
	Canadice Lake Outlet near Hemlock	4-2290
	Honeoye Creek at Honeoye Falls	4-2295
	Honeoye Creek at East Rush	4-2300
	Oatka Creek at Warsaw	4-2303.8
	Oatka Creek at Garbutt	4-2305
	Black Creek at Churchville	4-2310
	Genesee River at Rochester	4-2315
	Genesee River at Driving Park Ave., Rochester	4-2320

tent from sampling results in 1964, were selected as tentative sites for waste assimilation capacity studies. Time of travel determinations were made for reaches of Canaseraga, Honeoye, and Oatka Creek and two reaches of the lower Genesee River. Three time of travel studies were made during the period of May 11 to November 5, 1965 at times of low, medium and high streamflow. The methodology consisted of introducing a fluorescent dye-tracer across the width of the stream at the beginning of the reach and tracking the movement of the dye by sampling at downstream stations. Two ounce water samples were collected at a station at 15 minute intervals to detect arrival of dye mass.

3. Basic Data on Surface Water Quality

The mobile water pollution laboratory was located at the sewage treatment plant in Geneseo Village, Livingston County, during the summers of 1964 and 1965. Laboratory determinations divided into three categories.

The analyses made on surface waters under Group 1 determined color, odor, turbidity, suspended matter, temperature, pH, carbon dioxide, dissolved oxygen, biochemical oxygen demand, total hardness, calcium hardness, alkalinity, coliforms and conductivity.

Analyses that were made under Group 2 determined total solids, suspended solids, free ammonia, organic ammonia, nitrites, nitrates and total phosphates.

Analyses made under Group 3 determined manganese, iron, silicas, sulfates, ABS, and fluorides.

The sampling of the main stem of the Genesee River was started on June 12, 1964. The first phase of the sampling program consisted of a reconnaissance for DO, pH and conductivity to determine a comprehensive

evaluation of the water quality within the basin. Selected samplings for coliforms and BOD's were made in areas of extreme degradation. The sampling program covered approximately 200 stations and gave an overall picture of the condition of the river and its tributaries at the time of sampling.

The second sampling program was started during the third week in July 1964. The number of sampling stations was narrowed down to approximately 160. Samples collected at each sampling station were analyzed for those determinations listed under Group 1, Group 2 analyses were made on samples collected at selected sampling stations. The third sampling run was completed during the last week in October 1964.

A carbon filter installation was established on the Lower Genesee River approximately five miles from the lake and four samples were collected during the latter part of January and the first part of February. The second sample was collected during the first part of July and the third and fourth runs were made during the months of August and September. The carbon from the container was removed at the State Department of Health laboratory in Albany, prepared for shipment and sent to the Public Health Service laboratory in Chicago for analyses.

The Department of Health implemented a sampling program in compliance with Section 1210 of the Public Health Law which specifies that it shall be the duty and the responsibility of the Department to establish a water quality surveillance network with sufficient stations in sampling schedules to meet the needs of the State. Seven stations were selected within the Genesee River Basin plus a station in the vicinity of Rochester on Lake Ontario to survey and monitor the water quality in this area. These stations

are located on the Genesee River at Wellsville, Geneseo, Ballantyne Bridge, above and below the discharge from Eastman Kodak on the Lower Genesee River, near the mouth of Honeoye Creek, Oatka Creek, and in Lake Ontario at the water supply intake for the City of Rochester. Samples are analyzed for chemical, radioactivity, bacteriological, plankton, and pesticide parameters.

A preliminary survey on the use of pesticides in the basin was made and three areas were selected to determine the possible contamination of ground water. Surface waters were sampled in the same area in which the ground waters were sampled for pesticide determinations.

4. Waste Assimilation Capacity

The results of the dissolved oxygen and biochemical demand determinations made during 1964 in the tributaries and main stem of the Genesee River were tabulated and plotted. Reaches of the stream into which a high waste load was being discharged, as indicated by high BOD and low dissolved oxygen content, were selected as tentative sites for waste assimilation capacity studies. This selection involved approximately 10 reaches within the basin, and comprised about 90 stream miles. Budget limitation and monies available for the time of travel studies restricted the initial choice to only five reaches involving approximately 30 stream miles. The five reaches selected for intensified stream and effluent sampling were: (1) the Genesee River main stem between U.S. Route 104 and Lake Ontario, (2) Genesee River main stem south of Barge Canal and north of Ballantyne Bridge, (3) Honeoye Creek vicinity of Honeoye Falls Village, (4) Oatka Creek vicinity of Village of Warsaw, and (5) Canaseraga Creek, vicinity of the Village of Dansville.

One station was selected at the point of waste discharge into the stream and a minimum of five additional stations were selected along the stream. The waste effluent was sampled over a period of 36 hours. The samples generally were composited at four hour-intervals. Samples were collected at stream stations during the early morning, mid-afternoon and mid-forenoon for two consecutive days; these were analyzed to evaluate reaeration, deoxygenation, and other factors necessary for stream model prediction. A total of three runs were made on each of the reaches selected during June, August and October.

5. Future Water Quality Management Needs

The present and anticipated future development of the basin was established by the economic base study. The present uses of the stream and the economic feasibility through treatment of wastes and flow regulation for quality control were taken into account. It is recognized that many of these uses will be of a conflicting nature and that the complete or partial failure to satisfy these needs will have an economic and social consequence on the development of the basin and the people living in it.

The projections of population and economic growth for the basin as provided by the economic base study was translated into municipal and industrial water demands and associated waste loads. The present water uses within the basin were evaluated as well as the present classifications as they now exist under the laws of New York State. The data collected on the present quantities and qualities of water, both surface and ground, were studied to determine the availability of water for the various future needs for the specific subareas of the basin.

Recommendations are made as to the future water quality goals for the various reaches of the Genesee River and its tributaries. These goals establish the minimum water quality needed to accomodate the anticipated future use of the stream assuring an optimum development of the related water and land resources of the basin in the next 50 years. The water quality goals recommended were made on the basis that a technically and economically feasible degree of treatment and flow regulation would be provided. The plan for the water quality management of the Genesee River Basin is set up in conjunction with a water quality monitoring program that can be used to update and adjust, where necessary, the actual needs of the basin as they develop in the future.

The benefit of storage for quality management in proposed reservoirs was evaluated. The value of storage was determined by alternate cost methods. Reservoirs proposed for federal construction will be subject to the restriction that adequate treatment of wastes is effected at their source.

Chapter II

DESCRIPTION OF STUDY AREA

A Geography

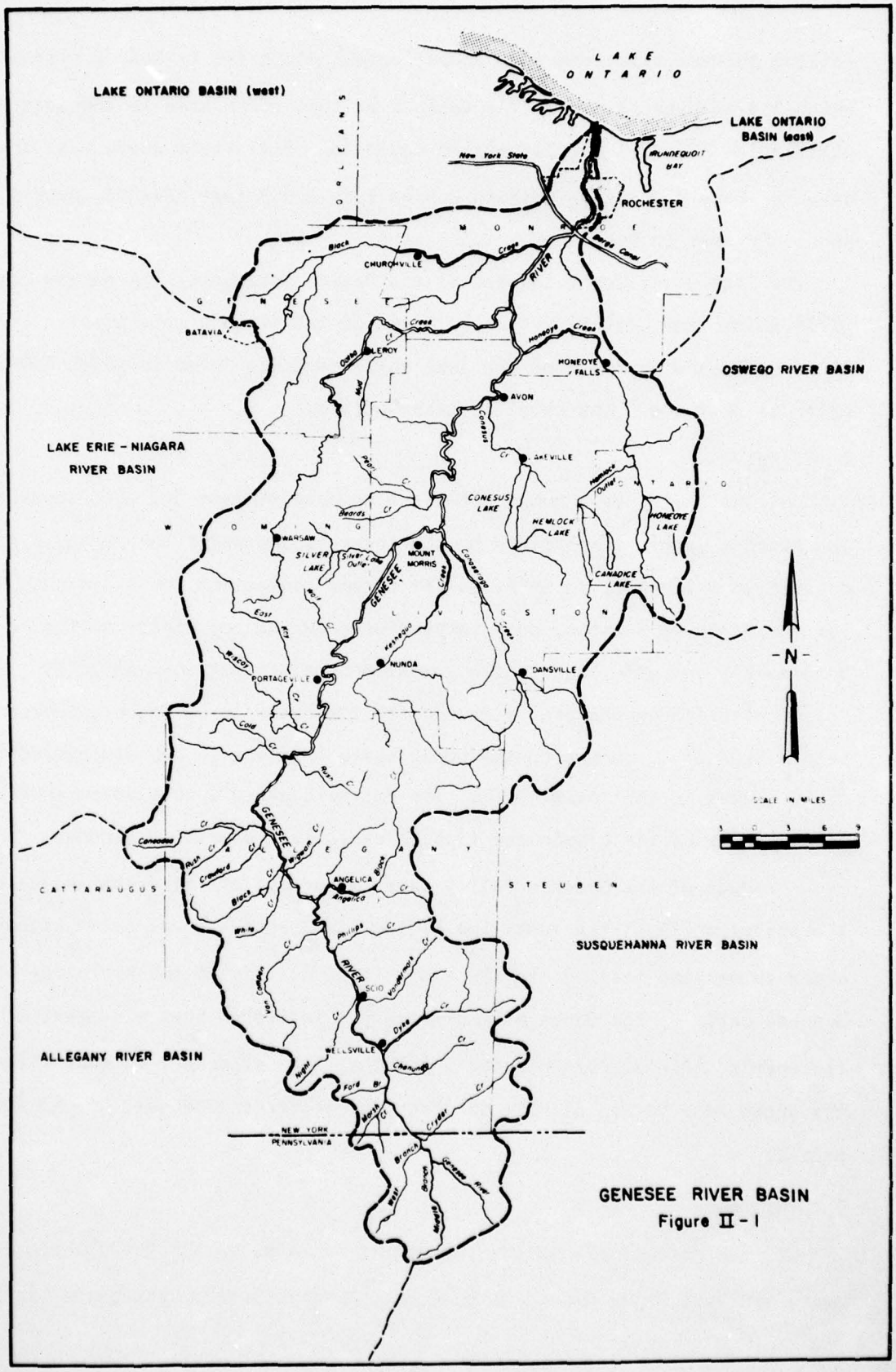
The Genesee River Basin, as shown in Figure II-1 is located in western New York and northern Pennsylvania. The basin drains an area of 2,480 square miles, of which 2,384 square miles are in New York and 96 square miles are in Pennsylvania. It has a length in a north and south direction of about 100 miles and a width east and west of about 40 miles.

The basin is bordered on the north by Lake Ontario, on the west by Lake Erie-Niagara River Basin, on the east by the Oswego River Basin and on the south by the watersheds of the Allegany and Susquehanna Rivers. The Genesee River rises in the Allegany Mountains, a few miles south of the New York-Pennsylvania Border, then flows in a general northwesterly and then northeasterly direction, to empty into Lake Ontario at Rochester. The River has a length of about 158 miles and falls on an average of 13 feet per mile. Its principal tributaries are Canaseraga, Honeoye, Oatka, and Black Creeks. The Barge Canal crosses and contributes to the river flow, on a regulated basis about Rochester.

B Topography and Soils

The Genesee River Basin, topographically, consists of a series of terraces descending northward from the Allegany Plateau to Lake Ontario, and separated by northward facing escarpments. The Allegany Plateau has its northern edge at the Portage Escarpment, which cuts across the Basin on an east-west line north of Mt. Morris. The surface of the Plateau is a weathered glacial till composed of silt and gravel with numerous stones and boulders. The Plateau has many ridges that have summit elevations ranging from 2,000 to 2,500 feet above mean sea level.

North of the Portage Escarpment and extending to the Niagara Escarpment in Rochester is the Erie and Huron Plains area. This is a



GENESEE RIVER BASIN
Figure II - 1

rolling surface with long easy slopes except along the tributary streams which lie in deep ravines. The surface of this plain area is composed of postglacial alluvial and lacustrine deposits. Elevations above mean sea level of this undulating terrain varies from 1,000 feet near Mt. Morris to about 400 feet in Rochester.

The last significant terrace of the Basin consists of the narrow lake plain within the City of Rochester north of the Niagara Escarpment. Elevations in this area are from 400 feet above mean sea level to about 250 feet, which is just above the level of Lake Ontario.

C Climate

The Basin has a humid climate with cold winters and mild summers. The average yearly temperature in the lower basin, where Lake Ontario has a moderating influence, is 50°F; in the higher elevations the average is 44°F. For the Basin as a whole, mean temperatures during the winter months range between 20° and 30°F, and in the summer months between 66° and 70°F.

Average annual precipitation for the Basin is 34 inches, decreasing from a high of 42 inches in the upper basin (highest in the western sector) to 28 inches in the lower basin. The entire Genesee watershed is subject to local storms of the cloudburst type, especially the western sector.

Much of the Genesee Valley constitutes one of the driest areas of the state, while at the same time having temperatures equal to or higher than other summertime readings in the state (1). A study of the hydrology of the Genesee Basin by the Corps of Engineers (2) indicated that a summertime deficiency of rainfall often occurs, and that the deficiency extends through the upper four inches of soil as a regular occurence for some of the summer period.

D Hydrology

The main water courses and bodies of water in the Basin include the Genesee River, Black Creek, Oatka Creek, Honeoye Creek, Canaseraga Creek,

Wiscoy Creek and the lakes of Hemlock, Conesus, Honeoye, Canadice, Rushford and Silver. The drainage areas, length, and average slope of the major streams are shown in Table II-1. Figure II-2 is a presentation of complete profiles for the Genesee River and its principal tributaries.

Table II-1

DRAINAGE AREA, LENGTH AND AVERAGE SLOPE OF MAJOR STREAMS IN THE GENESEE RIVER BASIN

STREAM	DRAINAGE AREA (SQ. MILE)	LENGTH OF STREAM (MILES)	AVERAGE SLOPE FT/MILE
Genesee River above Portageville	982	62	8.9
Genesee River - Portageville to Mt. Morris	100	20	---
Genesee River - Mt. Morris to Rochester	1400	70	0.8
Genesee River - Lower Falls to Lake Ontario	----	6	---
Black Creek	192	56	13
Oatka Creek	215	60	20
Honeoye Creek	266	34	8
Canaseraga Creek	335	44	54
Wiscoy Creek	109	60	

The Barge Canal crosses the Genesee River nearly at right angles south of Rochester. There are guardlocks on either side of the River crossing which permit the regulation of canal waters diverted from Lake Erie. Part is diverted into the Genesee River and part into the eastern sector of the Canal. Rochester Gas and Electric is entitled to divert up to 375 cfs, when available, of canal water into the Genesee River. Adequate flows for navigation in the canal have a priority in use of the canal water and, as such, the diversion is usually less than 300 cfs.

On a cfs per square mile basis, the annual average flow in the Genesee River is about 1.10 cfs per square mile at Rochester and 1.25 cfs per square mile in the headwaters (3) at Scio. The value for Rochester is high

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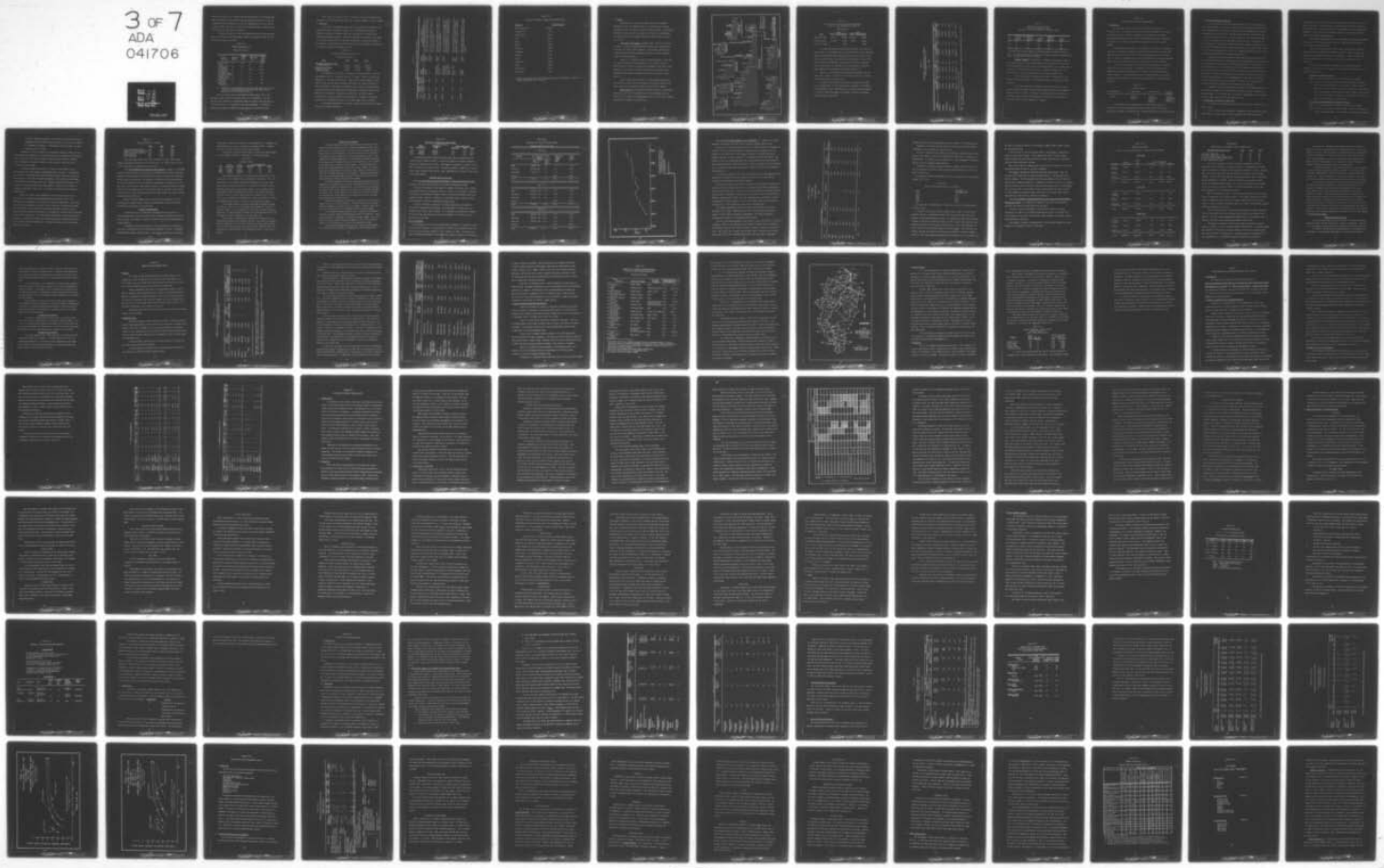


because it reflects flow diverted from outside the Basin via the Barge Canal. Other significant annual average flows per square mile include 1.00 cfs for Canaseraga Creek at Groveland, 1.12 cfs for Genesee River at Avon, 0.83 cfs for Black Creek at Churchville, 0.85 cfs for Honeoye Creek at Honeoye Falls, and 0.95 cfs for Oatka Creek at Garbutt.

The mean, minimum and 7 day low streamflows occurring once every ten years as observed at long-term gauging stations are shown in Table II-2 for the major streams in the Basin.

Table II-2

STREAM FLOW RECORDS (3)

Genesee River Basin

STREAM LOCATION	YEARS OF RECORD	MINIMUM FLOW (cfs)	7 DAY 1-IN-10 LOW FLOW (cfs)	ANNUAL MEAN FLOW (cfs)
Genesee River Scio	47	5.8	15	385
Genesee River Mt. Morris	53	12	70	1,600
Genesee River Rochester	43	10	370(1)	2,738
Canaseraga Creek Shakers Crossing	8	11	17	247
Honeoye Creek Honeoye Falls	18	.1	0.3	167
Oatka Creek Grabutt	18	3.3	19	198
Black Creek Churchville	18	0.3	0.9	102

(1) Computed for period 1949-60; during the 1949 water year the low-flow pattern of diversion from the canal was changed from a maximum of 600 cfs to about 375 cfs.

Flow in the main river is regulated at the Mt. Morris Dam in the Letchworth gorge located about forty miles south of Rochester. This dam provides flood protection to downstream lands and controls drainage area of 1,077 square miles, or 44 percent of the entire watershed. The reservoir created by the dam has a maximum storage capacity of 337,000 acre-feet.

With regard to the major lakes in the Basin, Table II-3 describes the approximate surface area, present regulation and major feeder and outlet streams.

E Population

The present and projected populations of the principal subareas in the Genesee River Basin are shown in Table II-4. The tabulation includes all communities partially or wholly within the Basin and all of Monroe County (Rochester Metropolitan Area). It would be impractical to report on only parts of the Rochester area since the drainage boundaries cut through the middle of the economic unit minimizing the meaningfulness of any projections of population or industrial growth in individual sectors.

Table II-4

Present and Projected Populations

Genesee River Basin

Area	1965	1980	2020
Rochester Metropolitan Area			
Monroe County	638,900	800,000	1,369,000
Central Plains Area	90,600	106,900	153,800
Allegany Plateau	35,800	37,200	40,600

The population of the Basin including all of Monroe County in 1960 was approximately 700,000. Estimates for 1965, as shown in Table II-4, place the population of the same area at 764,600. Most of this recent growth has taken place in Monroe County, which increased from 586,000 to 638,900, and most of the future growth of the Basin is projected in this county. By 1980 the Basin (including Monroe County) population is projected to increase to 943,800; the Monroe County population is expected to be 800,000. By 2020 the Basin (including Monroe County) population is projected to increase to 1,369,000; Monroe County is expected to account for an even larger share, 1,153,000.

The estimated population of the major incorporated municipalities within the Basin is shown on Table II-5.

Table II-3

DESCRIPTION OF LAKES IN THE GENESEE RIVER BASIN

NAME	SURFACE AREA (SQ. MILES)	DRAINAGE AREA (SQ. MILES)	FEEDER STREAMS	OUTLET STREAMS	PRESENT REGULATION AND NATURE OF DRAINAGE AREA
Honeoye	2.61	41.1	Honeoye Inlet	Honeoye Creek	Lake level controlled; used extensively for recreation; heavy cottage development.
Canadice	0.97	12.4	-----	Canadice Outlet	Lake level controlled; water supply reservoir for City of Rochester; limited access; No cottage development.
Hemlock	2.90	43.6	Springwater Cr., Reynolds Guly Cr.	Hemlock Outlet	Lake level controlled; water supply reservoir for City of Rochester; limited access; No cottage development.
Conesus	5.08	69.7	Wilkins Cr., N. McMillan Cr., Conesus Inlet, S. McMillan Cr.	Conesus Creek	Lake level controlled; water supply reservoir for villages of Avon, Geneseo and Lakeville; extensive cottage development; heavy pressure for all recreational uses.
Silver	1.19	17.3	Silver Lake Inlet	Silver Lake Outlet	Lake level controlled; water supply reservoir for villages of Perry, Mt. Morris, and LeRoy (part); extensive recreational use.
Rushford	0.91	61.1	Canadea Creek	Canadea Creek	Power supply reservoir operated by Rochester Gas and Electric; 25,000 AF of usable storage

Table II-5

Population of Major Incorporated Municipalities

Community	1965 Population*
City of Rochester	313,832
Churchville	1,070
Honeoye Falls	2,300
Avon	3,021
Perry	4,218
Warsaw	3,836
Dansville	5,624
Caledonia	2,128
Geneseo	3,540
Nunda	1,236
Wellsville	5,967
LeRoy	4,880
Scottsville	2,033
Mt. Morris	3,250

*Figures interpolated from New York State Conservation Department, Division of of Water Resources, data of 4/19/66.

F Economy

Spearheaded by the vigorous growth rate of the Rochester Metropolitan Area, the Genesee Basin, as a whole, has an excellent economic outlook. The basin's growth is highly variable. The Rochester Metropolitan Area should closely parallel the Nation's growth while the Central Plains and Allegany Plateau will, most likely, continue to lag (4).

Agriculture and Forestry encompass about 1.3 million acres in the basin. Cropland occupies 40 percent of the basin, pasture about 15 percent and forest land 27 percent. The principal agricultural activities produce poultry and dairy products, livestock, vegetable crops, and forest products.

Generally, the area has some of the best farmland in the State and has been predominantly agricultural in the economic activity. There has been a decline in agricultural employment from 1940 to 1960 especially in the Central Plains area where the vast manufacturing employment opportunities of nearby Monroe County have been a major factor.

Sales of agricultural products in 1959 averaged about 15 million dollars in each of the five counties of the basin, ranging from about 10 million in Allegany to more than 18 million in Monroe.

Manufacturing is a significant economic activity in the Genesee River Basin, and in the Rochester Area it is the dominant activity. Table II-6 is a summary of the employment picture in the basin, showing the population employed in manufacturing.

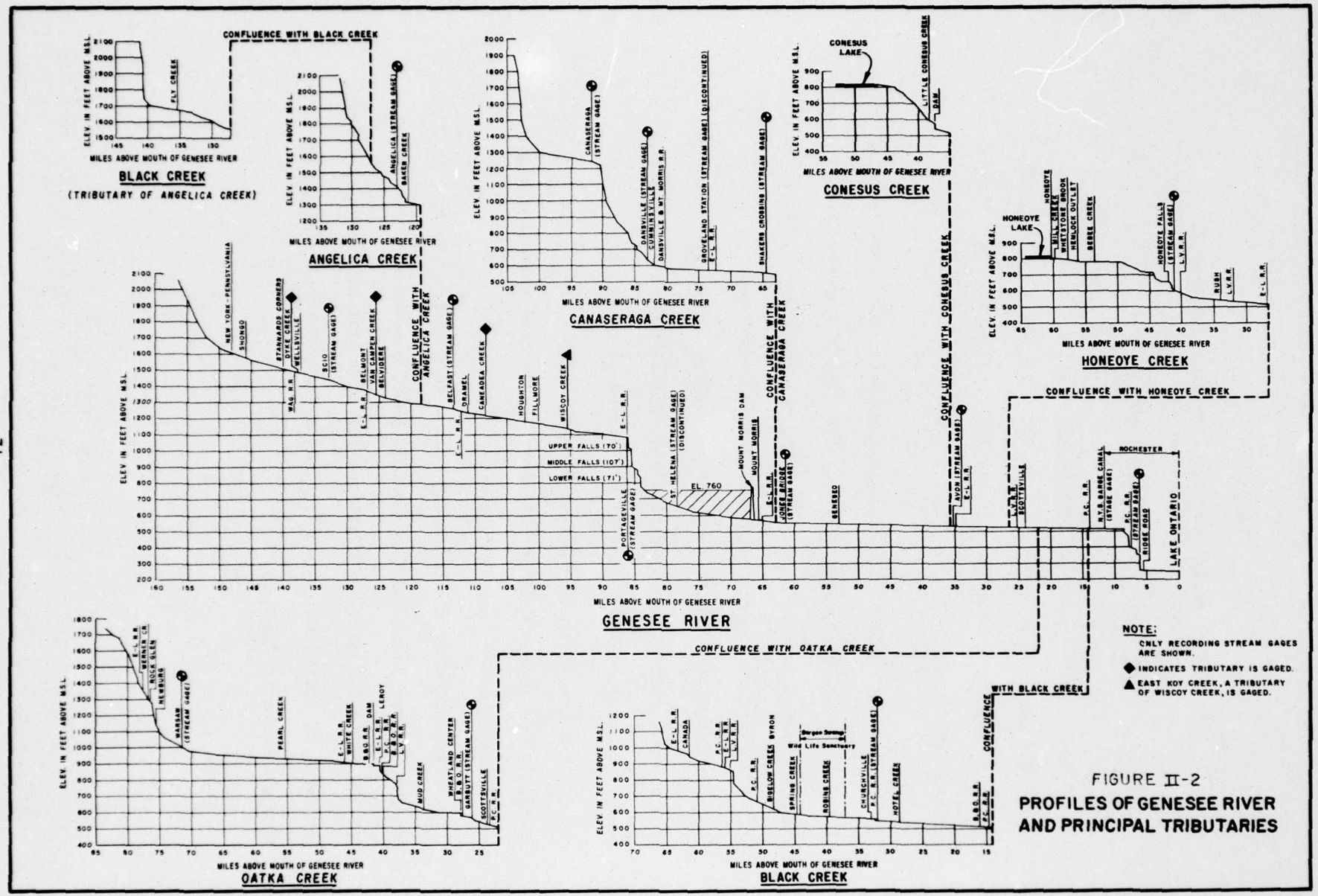


FIGURE II-2

PROFILES OF GENESEE RIVER AND PRINCIPAL TRIBUTARIES

Table II-6

Total Employment and Manufacturing Employment
in Areas of the Genesee River Basin (4)

1950 and 1960

Area	1950		1960	
	Total	Manufacturing	Total	Manufacturing
Rochester SMSA	202,200	90,000	231,200	98,900
Central Plains	65,900	17,700	71,800	20,900
Allegany Plateau		3,500		3,900

As shown, manufacturing establishments employ nearly half the labor force in the Rochester Area. The 1962 "County Business Patterns Report" listed Monroe County as having the following number of manufacturing establishments with more than 100 employees in each of the major industrial catagories: Food and allied products, 19; paper and allied products, 5; chemicals and allied products, 4; primary metal products, 4; instruments and related products, 17.

Figures on value added by manufacture are presented, for the years 1947 - 1963, in Table II-7 for the counties which lie entirely or partially within the Study Area.

As seen from the preceding discussion, manufacturing growth in the Genesee Basin is, for the most part, dependent on the growth of the Rochester Area. Projections for this area have been compiled in terms of future employment for the major industrial categories and are shown in Table II-8.

Table II-7

VALUE ADDED BY MANUFACTURING IN COUNTIES
OF THE GENESEE RIVER BASIN (12)

1947 - 1963

COUNTY	1947		1954		1958		1963	
	X $1,000	% B	X $1,000	% B	X $1,000	% B	X $1,000	% B
Allegany	14,334	2.4	25,090	2.4	29,384	2.4	32,239	1.8
Genesee	33,795	5.7	56,428	54.	56,717	4.6	88,369	4.9
Livingston	12,103	2.1	18,305	1.8	26,449	2.2	32,203	1.8
Monroe	514,513	87.5	917,779	88.6	1,096,424	89.1	1,627,087	89.6
Wyoming	13,594	2.3	18,135	1.8	20,491	1.7	33,836	1.9
	588,339	100.0	1,036,737	100.0	1,229,465	100.0	1,813,734	100.0

NOTE: % B - Percent county value added by manufacturer is based on the total contribution of the five counties in the Basin.

Table II-8

Employment Indices for Major
Industrial Categories in the
Rochester Standard Metropolitan Statistical Area*

YEAR	CHEMICAL AND ALLIED PRODUCTS	FOOD AND KINDRED PRODUCTS	PRIMARY METALS	PAPER AND ALLIED PRODUCTS	OTHER MFR.
1960	100	100	100	100	100
1990	117	127	115	125	209
2020	158	135	120	144	266

* Rochester SMSA includes Monroe, Livingston, Wayne, and Orleans Counties

Note: Data extracted from "Water Pollution Control Program for Genesee River Basin" by FWPCA and NYS Dept. of Health.

Waterway commerce is enhanced by a commercial navigation channel in the lower three miles of the Genesee River for lake vessels and by the New York State Barge Canal which crosses the Genesee River in the southern part of Rochester. From this crossing the river is improved northward into the central part of the city where terminal facilities are maintained.

The principal products handled at the Port of Rochester are coal, cement, salt, and newsprint. An estimated 300 ships use the port facility annually.

Use of the Barge Canal in Rochester has been declining in recent years. Only 200,000 tons of freight were shipped by barge in the Rochester-Lockport Section in 1965. The number of pleasure craft using the canal on the other hand, has more than quadrupled in the past 10 to 15 years, as reflected in the number of permits for lockage.

Chapter III

MUNICIPAL AND INDUSTRIAL WATER DEMANDS

A Introduction

An unlimited quantity of high quality water for municipal and industrial use is an absolute must for the economic development of the basin. One of the principal underlying assumptions of the Economic Base Report developed for the basin is that "sufficient quantities of water of acceptable quality will be available to support the economy and facilitate economic growth".

The purpose of this section of the report is to inventory the present municipal and industrial demand as to quantity and sources and to project this demand to the years 1980 and 2020. These projections will be used as guide lines in framing a comprehensive plan for the development of the water resources within the basin to meet the potential municipal and industrial demands.

In Economic Base Report, the counties are grouped wholly or partially within the basin into subareas. The boundary lines of the subareas were established by examining the physical and economic relationship among the various counties. The counties within the basin were grouped into subareas according to their economic similarities and physiographic characteristics as follows:

Table III-1

Economic Subareas

1. Metropolitan	2. Barge Canal	3. Central Plain	4. Allegany Plateau
Monroe	Orleans	Genesee	Allegany
	Wayne	Livingston	Cattaraugus
		Ontario	Steuben
		Wyoming	Potter (Pa.)

The Rochester area is designated as the "Standard Metropolitan Statistical Area" of the Genesee River Basin by the Economic Base Study. A population of 50,000 is the minimum for a Standard Metropolitan Statistical Area.

B Subareas Determined by Water Use

A water supply system may be characterized by its source, treatment, water quality, type of consumer, per capita use, transmission and service area. These characteristics are dependent upon the geology, topography, and economic development of the area served. The physical and economic relationship that set apart counties within the basin into subareas in the "Economic Base Report" reflect on the type of system developed to serve the area. A review of the data pertaining to water supply systems within the subareas established by the "Economic Base Report" revealed characteristics peculiar to water supply systems that would have categorized the Basin into subareas almost identical with those boundaries established by the "Economic Base Report".

Present municipal and industrial water demand data and projections for the future are limited to the drainage basin with the exception of Monroe County. The drainage basin of the river cuts through the western and central area of Monroe County but due to the narrowness of the drainage area near the mouth of the river only a small portion of the City of Rochester falls within the basin. Projection of future waters demands for this portion of the basin would be unrealistic and meaningless if the interdependency of the City and surrounding towns in Monroe County was not considered. Therefore, all of Monroe County including the City of Rochester was considered in the inventory.

The present municipal and industrial demands for this Metropolitan Area far exceeds the demand for the remaining area within the Basin. Hemlock and Canadice Lakes, in the Genesee Basin, contribute a large portion of the present municipal water supplies to this Metropolitan Area.

C Methodology - Projection of Water Use

The problem of projecting non-industrial water use for a community is a difficult one.

The total daily water consumption is dependent on the population and per capita demand. The per capita use for communities will differ among other

things with cost, quality, pressure, individual habits, consumer cost distribution, and personal income levels. Accurate accounting of water production and consumption by various classification of consumer is a rarity among water purveyors. These records are maintained generally only by large suppliers like those located in Monroe County.

The Economic Base Study Task Group made population projections through the year 2020. These projections, based on the 1960 census, were made on a county, town, and village basis.

Data collected on the public water supply systems within the Basin were analyzed for consumption and population served. Known industrial consumption was subtracted from the total consumption. A figure of daily per capita consumption for non-industrial use was then determined from the remainder.

The following formula was developed for use in projecting non-industrial water demand to be supplied by a municipal system within the basin excluding Monroe County.

Allegany and Steuben Counties -

1965 - Use reliable data when available, otherwise use 85 gpcd.

1980 and 2020 - If 1965 data is below 85 gpcd, increase to 100 gpcd by 1980 and 120 gpcd by 2020. If 1965 data is greater than 85 gpcd but less than 120 gpcd, increase at the rate of 1 percent per year non-compounded up to 100 gpcd and then increase at the rate of 0.5 percent to a maximum of 120 gpcd. If 1965 data is above 120 gpcd, use same figures for 1980 and 2020.

Livingston, Genesee, Wyoming and Ontario Counties -

1965 - Use reliable data when available, otherwise use 95 gpcd.

1980 and 2020 - If 1965 data is below 95 gpcd, increase to 105 gpcd by 1980 and 125 gpcd by 2020. If 1965 data is greater than 95 gpcd but

less than 125 gpcd, increase at the rate of 1 per cent per year non-compounded up to 100 gpcd and then increase at the rate of 0.5 percent to a maximum of 125 gpcd. If 1965 data is above 125 gpcd, use same figures for 1980 and 2020.

Prediction of future demand for self-supplied industrial water and that supplied by small communities is even more difficult than projecting non-industrial use. Contact with the various industries within the Basin outside of Monroe County revealed poor records on present and past usage of water and lack of planning for future needs.

The Economic Base Study provides an index of future growth in total manufacturing and future growths of employment within the Basin. In developing the indices it was assumed that sufficient water would be available to meet production needs. Using this assumption, production is not related to water reuse or efficiencies in industrial water use. Therefore, production indices are not suitable for projecting industrial water demands. Because of such factors as automation, employment indices are not suitable for determing future industrial water demands.

Water use indices were developed for each of the major water using industries in the Rochester Standard Metropolitan Statistical Area. The methodology was developed by correlating past trends in employment in each water using industry, employment projections for the Lake Ontario Watershed developed for such industries from the Office of Business Economics, and water use per employee industry projections contained in the report of the Senate Select Committee on Nation Water Resources. This method gave consideration to county manufacturing employment, a productivity factor, and a water reuse factor determined from data collected for the Eastern Great Lakes. The resultant indexes for the Rochester SMSA were as follows:

Table III-2

Industrial Water Use Indices

	1965	1980	2020
Food and Kindred Products	100	133	194
Chemical and Allied Products	100	149	243
Paper and Allied Products	100	117	144
Primary Metals	100	119	159
Other Industries	100	173	266

The larger index numbers for "Other Industries" is due to more rapid growth in employment projected for such industries. The current water use base for such industries is probably relatively small.

Table III-3 Municipal and Industrial Water Demands located in the appendix summarizes demands within the drainage basin excluding Monroe County, these were developed from the population projections, per capita use formula and industrial indices previously described. The population served within the towns projected for the years 1980 and 2020 were arbitrarily determined by assuming that if the town had an existing public water supply system, the increase in population served would be in direct proportion to the projected growth of the town. Public water supply systems in towns of decreasing population were assumed to continue to serve the present population load.

Table III-4 Water Supply Inventory located in the appendix lists the existing water supplies within the Basin excluding Monroe County with a brief description of the physical characteristics.

Allegany Plateau Subarea

A large portion of the land area of Allegany County lies within the Genesee Drainage Basin along with small areas of Steuben, Cattaraugus and Potter (Pa.) Counties. This area is a subarea of the Basin and has been designated the Allegany Plateau.

The population within the subarea is not centralized in any significant area, but is concentrated in small communities throughout the area. A review of the public water supply systems listed in Table III-4 indicates that the systems

serve small hamlets and villages that are geographically independent and each distribution system is supplied by a separate source. Allegany Plateau is served by 16 public water supply systems.

The present and projected municipal and industrial water demands for the Allegany Plateau are summarized in the following table.

Table III-5

Allegany Plateau

Year	Basin Population	Served by PWS	Water Demand MGD		
			Non-Ind.	Ind.	Total
1965	35,800	18,100	1.9	0.6	2.5
1980	37,200	18,500	2.1	1.0	3.1
2020	40,600	19,800	2.5	1.4	3.9

Ground water, because of its economics and convenience, is the source of all the supplies with the exception of Wellsville. The village, which is the largest incorporated community in the area, takes water from the Genesee River, but it is presently considering the possibility of developing a ground water supply. This consideration has been brought about by needed plant renovation and highway relocation near the vicinity of the village intake and transmission main. Wellsville, with a population of approximately 6,000, is considered a secondary employment area within the basin by the Economic Base Report.

The Allegany Plateau is sparcely populated and employment opportunities are limited. The total present water demand for the entire Allegany Plateau is only 2.5 MGD, and this includes 1.0 MGD consumed by Wellsville, 0.2 MGD consumed in Steuben County and approximately 0.1 MGD consumed by two small communities in Potter County, Pa.

The remaining 1.2 MGD presently consumed in Allegany County is distributed by twelve small community systems. The source as indicated above is ground water. This water is generally of good, sanitary quality, but high iron, manganese and hardness require treatment other than chlorination to produce water of an acceptable quality in some of the systems.

Central Plains Subarea

Livingston County lies almost entirely within the Central Plains subarea along with large portions of Genesee and Wyoming Counties and a small section of Ontario County. This area is more suburban than the allegany Plateau and the population in the northern part of this subarea is increasingly being affected by the Rochester Metropolitan Area. The subarea has a greater predominance of surface water available for municipal consumption and typifies the rest of New York State in that the bulk of the population is served by surface waters. The classification of waters within New York State, based on best usage, implies that the primary use of surface waters is for public water supply, and the lakes in this area have been classified for the purpose. Honeoye, Canadice, Hemlock, Silver and Conesus Lakes lie within the Central Plains area and are classified as sources for public water supply.

The largest quantity of water for municipal use produced from the resources of the Genesee Basin has been that supplied to the City of Rochester from Canadice and Hemlock Lakes. This system will be discussed in greater detail in the section of the report on the Rochester Metropolitan area. Only a small quantity of this production has been utilized for municipal use in the Central Plains subarea and this use has been made available only in recent years.

The Hamlet of Hemlock is furnished at present with water from the supply line to the city of Rochester. Favorable negotiations have been made by villages of Livingston County and hamlets in Ontario County with the City of Rochester to use the Hemlock System as a water supply.

The Village of Warsaw, Wyoming County is especially interested in obtaining additional water from proposed dam site 18-7 (Appendix J. Agricultural Report) to supplement its present municipal supply. The site is one of the better sources located and appears to be on land presently owned by the Village which is a part of the water works system.

The present and projected municipal and industrial water demands of the Central Plains subarea are summarized in the following table.

Table III-6

Municipal and Industrial Water Demand

Central Plains

Year	Basin Population	Served by PWS	Water Demand MGD Non-Ind.	Ind.	Total
1965	90,500	45,700	5.2	6.0	11.2
1980	106,900	53,600	6.5	9.1	15.6
2020	153,800	74,100	9.4	13.3	22.7

The present population served by public water supply systems within the Central Plains subarea is 45,700. The total municipal and industrial demand is presently estimated to be 11.2 MGD. This demand is projected to increase to 15.6 MGD in 1980 and to 22.7 MGD in 2020. The present demand is supplied by 21 public water supply systems; surface waters supply approximately 80 percent of the public water supply demand.

Rochester Metropolitan Area

Table III-7 Municipal and Industrial Demand - Rochester Metropolitan Area indicates the water demand created by the Rochester Metropolitan Area.

The bulk of the present total demand is supplied by Rochester City, Monroe County Water Authority and private industrial sources. The Villages of Brockport, Churchville, East Rochester, Fairport, Hilton, Pittsford and Webster have independent municipal supplies. Caledonia, in Livingston County, supplies a small water district in the Town of Wheatland, Monroe County.

A review of the data collected on the present population and water use indicate that approximately 95 percent of the population in Monroe County is served by public water supply systems. It is assumed, in projecting the demands for 1980 and the year 2020, that the entire population of the County will be served by the year 1980.

City of Rochester

Figure III-1 is a plot of the average water consumption for the past 24 years for the City of Rochester. The population of the City has decreased according to the U.S. census data from 332,488 in 1950 to 318,611 in 1960. In spite of this trend of decreasing population, the average daily water consumption is increasing.

Table III-7

Municipal and Industrial Water Demand

Rochester Metropolitan Area

Year 1965

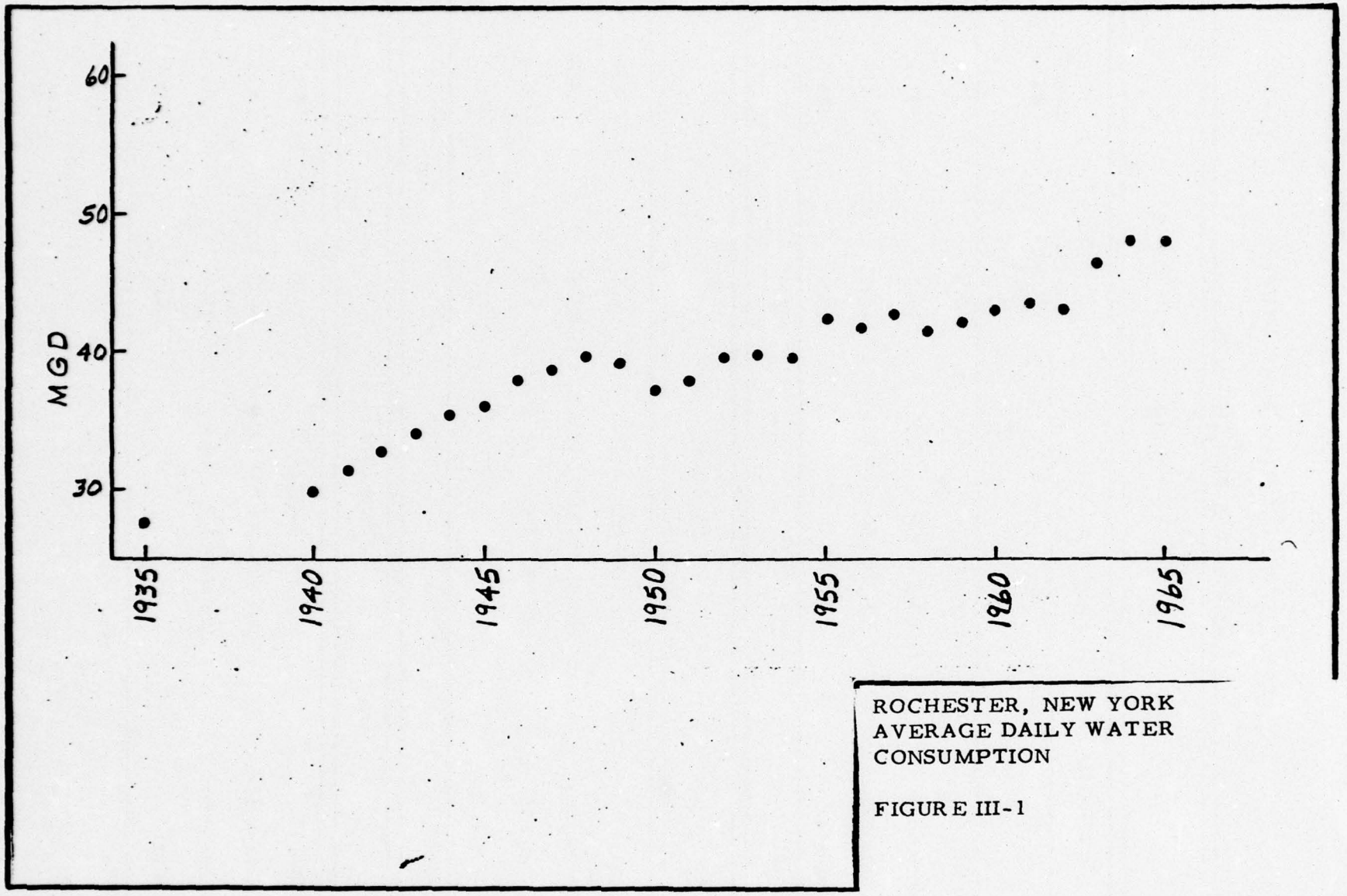
SUPPLIER	NON INDUSTRIAL WATER DEMAND			INDUSTRIAL WATER DEMAND MGD	TOTAL DEMAND MGD
	Pop Served	Gpcd	Total Demand MGD		
MCWA	270,400	95	25.7	4.7	30.4
Rochester	280,300	123	34.5	13.7	48.2
Other PWS	52,700	95	5.0	1.5	6.5
Private				183.0	183.0
Total	603,400		65.2	202.9	268.1

Year 1980

MCWA	452,900	105	47.6	8.6	56.2
Rochester	266,800	125	33.4	25.8	59.2
Other PWS	80,000	105	8.4	7.2	15.6
Private				196.0	196.0
Total	799,700		89.4	237.6	327.0

Year 2020

MCWA	984,700	125	123.0	22.0	145.0
Rochester	255,300	125	31.9	56.6	88.5
Other PWS	129,000	125	16.1	21.0	37.1
Private				220.0	220.0
Total	1,369,000		171.0	319.6	490.6



ROCHESTER, NEW YORK
AVERAGE DAILY WATER
CONSUMPTION

FIGURE III-1

Table III-8 Total Water Demand, City of Rochester is a summary of the water production andconsumption of the City of Rochester between 1958 and 1965.

A tabulation of the major industrial users in 1959 indicates a consumption of 6.87 MGD. This industrial consumption subtracted from the average total consumption of 42.4 MGD shown in Table III-8 divided by an estimated population served by the City of 290,000 results in a 123 gpcd non-industrial demand. This figure includes the unaccounted water loss in the system and has been applied to the estimated population served by the City in 1965 to determine the non-industrial use. The non-industrial water use has been limited to 125 gpcd for the 1980 and 2020 projections.

The industrial demand for the City of Rochester shown on Table III-7 has been determined by projecting the total demand for the City to the year 2020 and subtracting the estimated non-industrial demand.

The City of Rochester, since 1875, has served City customers by drawing from Canadice and Hemlock Lakes which lie in the Genesee Drainage Basin approximately 30 miles south of the City. This system has been progressively developed over the years and now is composed of three conduit lines that will carry a maximum daily demand of approximately 48 MGD. The total drainage area controlled by the City of Rochester for water production is 66.4 square miles which include the water surface areas of the two Lakes and the outlet of Canadice Lake.

The reported dependable yield of the Hemlock system prior to 1942 was estimated to be 31 MGD. Proposals made at that time to increase the Hemlock supply to 50 MGD were only partially implemented. This partial expansion increased the capacity to an estimated 34 MGD capacity.

The City of Rochester presently sells retail to about 90 percent of the City's customers. Water is sold wholesale to the Hamlet of Hemlock and to the Monroe County Water Authority that serves the Towns of Mendon, Brighton, Henrietta, and Rush. The conduits pass through these southern towns in Monroe County as they carry water to the City. Favorable negotiations are being made to serve West

City of Rochester

Table III-8

Total Water Demand

MGD

Year	Sources of Supply: Hemlock	Lake Ontario	Purchased	Total	Sold to Municipalities	City Consumption
1958	29.5	13.1	-	42.6	2.7	39.9
1959	36.6	11.8	-	48.4	6.0	42.4
1960	38.4	10.5	-	48.9	5.8	43.1
1961	35.7	14.2	-	49.9	6.3	43.6
1962	34.5	16.6	0.4	51.5	8.3	43.2
1963	27.3	24.3	0.5	52.1	5.8	46.3
1964	28.7	21.6	0.5	50.8	2.5	48.3
1965	28.2	19.6	3.2	51.1	2.9	48.2
Ave.	32.6	16.5	0.6	49.4	5.0	44.4

Bloomfield, Ontario County and Livonia and Lima villages in Livingston County.

Treatment of the water from the Hemlock system consists of chlorination, fluoridation and the addition of copper sulphate.

The City of Rochester also maintains a 36 MGD water treatment plant on the shore of Lake Ontario. The plant is designed for coagulation, filtration and chlorination. This system, put into operation in 1954, supplements the Hemlock system in meeting average and peak demands.

The Monroe County Water Authority presently supplies the area within the City not supplied by the City system and makes water available to 15 of the 19 towns in the County.

Table III-9 indicates the average daily water consumption for the Authority between 1960 - 1964.

Table III-9

Monroe County Water Authority Consumption

Year	Ave. Daily Consumption-MGD
1964	31.0
1963	27.5
1962	25.1
1961	23.2
1960	22.7

The total daily average demand is increasing at the rate of approximately 2.1 MGD per year.

A review of the data on the public water supply systems in Monroe County excluding the City of Rochester indicates that the non-industrial water consumption averages approximately 95 gpcd. An assumption was made that this would increase to 105 gpcd in 1980 and 125 gpcd in 2020. These figures applied to the predicted population to be served by the Authority in the future produces the results shown for non-industrial water use in Table III-7. The industrial consumption has been calculated by projecting the inremental increase of approximately 2.1 MGD total demand and subtracting the estimate for non-industrial use.

The ratio of industrial demand to non-industrial demand remains almost constant for the periods shown.

A small portion of the water demand shown in Table III-7 is supplied by a number of small water systems. Future demands are shown for these systems although the Monroe County Water Authority has been progressing on a program to supply and lease these small systems.

Most of the industrial demand shown for these smaller systems is due to the anticipated growth of Xerox in the Town of Webster.

Table III-7 indicates self-supplied industrial water demand. This sum includes cooling water that is taken from Lake Ontario by the Rochester Gas & Electric Company. An 84" reinforced concrete pipe extending 2/3 of a mile into the lake has a designed capacity of 110,000 gpm at lake level of 247.2. The design capacity has been used in the total industrial water demand shown in Table III-7. This figure has been held constant for the projected demand for 1980 and 2020. The RG&E company has presently under construction a new nuclear power station approximately 18 miles east of the City of Rochester.

Table III-10 Present and Projected Municipal and Industrial Water Demands - Genesee River Basin is a summation by subarea of the present and projected municipal and industrial water demand for the Basin.

A review of the data presented in the tabulated summary illustrates drastically the impact of the Rochester metropolitan area on the present and future demands for municipal and industrial water compared to the other subareas designated within the Basin.

Table III-11 indicates the predominance of the Rochester Metropolitan Area compared to the remaining portion of the Basin.

Table III-10

GENESEE RIVER BASIN

Present and Projected Municipal & Industrial Water Demand

Year 1965

Sub-Area	Basin Population	Served by PWS	Water Demand MGD Non Ind.	Ind.	Total
Allegany Plateau	35,800	18,100	1.9	0.6	2.5
Central Plains	90,500	45,700	5.2	6.0	11.2
Rochester Metro Area	638,300	603,400	65.2	202.9	268.1
Total	764,600	667,200	72.3	209.5	281.8

Year 1980

Allegany Plateau	37,200	18,500	2.1	1.0	3.1
Central Plains	106,900	53,600	6.5	9.1	15.5
Rochester Metro Area	799,700	799,700	89.4	237.6	327.0
Total	943,700	871,800	98.0	247.7	345.6

Year 2020

Allegany Plateau	40,600	19,800	2.5	1.4	3.9
Central Plains	153,800	74,100	9.4	13.3	22.6
Rochester Metro Area	1,369,000	1,369,000	171.0	319.6	490.6
Total	1,563,400	1,462,900	182.9	334.3	517.1

Table III-11

Water Demands of Rochester Area in Genesee Basin

Rochester Metropolitan Area	1965	1980	2020
% of Basin population	83	85	88
% Served by PWS within Basin	90	92	94
% Non-Ind. Water Demand within Basin	90	91	94
% Industrial Water Demand within Basin	97	97	97
% Total Demand within Basin	95	95	96

The City of Rochester initiated a number of engineering studies to determine the most practical and economical method of supplementing the water supply from Canadice and Hemlock Lakes originally authorized in 1875. These two Lakes are natural lakes which have had their level raised to secure maximum storage. They have been developed for single purpose water supply use although limited recreation is condoned. Fishing and hunting are allowed by permit issued by the Rochester Water Bureau. All the land around each lake is owned by the City, from the shoreline back to a distance recommended by the State Health Department for optimum sanitary control

The City proposed, in 1927, to consider Honeoye Lake as the future water supply to supplement their existing supply. This proposal planned to raise the level of Honeoye Lake by 30 feet and ultimately supply the City with a total supply, including Canadice and Hemlock Lakes, of 100 MGD. This proposal, however, never was implemented by the City.

The City, experiencing a critical water shortage around 1950, determined that the most practical source of supply to meet their future needs was Lake Ontario. The total supply developed from Lake Ontario plus the upland supply is capable of satisfying the projected City demand to about 1986.

The Monroe County Water Authority was created to provide an adequate quantity of water for public use where needed in Monroe County. A detailed report was completed in 1958 which outlined a program to satisfy the projected water demand for the Towns in Monroe County. An active program of implementing the the recommendations in the report has been in progress since that date.

The report for the Monroe County Water Authority investigated a number of sources in the uplands south of Monroe County as a future supply for the County. Many of these sites had previously been considered by the City of Rochester. The report concluded that Lake Ontario, because of its unlimited quantity, a quality that could be made excellent with modern water treatment methods, and a supply that could be developed in stages, should be the principal source for Monroe County.

A 140 MGD intake and a 32 MGD treatment plant were put into operation by the Monroe County Water Authority in 1963. The treatment plant can produce approximately 50 MGD by increasing the original approved filtration rate. Plans are underway to increase the capacity of the treatment plant by 25 MGD; the ultimate capacity of the plant will be 100 MGD.

The Authority is planning to construct another treatment plant on the east side of Monroe County with an intake into Lake Ontario. The Rochester Metropolitan Area has been served adequately by the public water supply systems during the drought experienced in recent years. There are a number of interconnections between the City system and the Monroe County Water Authority. No curtailment of water use has been necessary by the City of Rochester since the completion of its treatment plant on Lake Ontario. Curtailment of water use by the County has occurred because of transmission and distribution problems rather than lack of quantity. Lake Ontario is now the prime source of water for the Rochester Metroplitan Area, supplying approximately 236 MGD of the 1965 total demand.

D. Source of Water Supply

Rochester Metropolitan Area

The water supply for the City of Rochester is primarily obtained from Lake Ontario and two upland lakes - Canadice and Hemlock. Lake Ontario is the present source of water for the Monroe County Water Authority.

At present, the Monroe County Water Authority is considering the development of single purpose impoundments in the Mud Creek watershed

capable of supplying an ultimate of 50 MGD. The major justification for this project is a saving in pumping costs. A 260-foot head differential exists between the mean low water elevation of Lake Ontario and the approximate weighted ground elevation of the Rochester metropolitan service area.

As an alternative to the development of single purpose upland impoundments the provision of water supply for the Rochester metropolitan service area will be considered in the multipurpose plan formulation for the Genesee River Basin. The potential economic benefits which could be achieved through the use of multipurpose upland impoundments in the Basin will be evaluated.

Areas located in central and southern Monroe County, because of the difference in elevation, present a problem of economics in pumping and distribution. Consumers presently being supplied in these areas by the Monroe County Authority are supplied by purchased water from the Upland Supply of the City of Rochester.

Central Plains Subarea

This area is blessed with five major lakes of the Finger Lakes Chain that naturally impound water for recreation and water supply. Past studies have indicated that efficient development of the water resources in this area, combined with redistribution of existing sources, would more than amply provide for the projected water demand in the year 2020.

Allegany Plateau Subarea

This area represents only a small portion of the present and projected water demand for the basin. The public supplies are small and separated geographically. Two supplies create approximately two-thirds of the demand. Small watershed development and ground water will adequately serve the water needs of this area.

Chapter IV

PRESENT AND FUTURE WASTE LOADS

A-General

The streams of the Genesee River Basin presently receive an estimated total waste loading of 93,000 pounds of 5-day, 20°C, BOD per day. This estimate does not include the loading carried to the river by the overflows from the combined sewer system of the city of Rochester.

About one-eighth of this total is from municipal systems, with or without treatment, and the remainder from separately discharging industries. With the installation of adequate treatment facilities, and accounting for the increase in population and industrial growth, this total loading will be 28,000 pounds per day of 5-day BOD in 1980 and 31,000 pounds in 2020. The municipal fraction will rise to about 20 per cent.

Agriculture and land runoff are other sources of waste that presently degrade the basin waters.

B-Municipal Waste

Existing municipal sewage treatment facilities in the basin generally provide inadequate treatment. Many facilities are inefficient or highly overloaded. *Table* IV-I, *a* summary of the 16 existing facilities in the Basin, shows that about forty-five per cent reduction of BOD is being effected on the wastes received at these plants; this is approximately equal to 12,000 pounds of 5-day BOD per day.

Allegany County, with 6,000 of its 30,700 population served by one facility provides very little treatment.

Genesee County has one-third of its 15,500 population connected to one facility, the Village of LeRoy treatment plant.

TABLE IV-1

SUMMARY OF EXISTING MUNICIPAL SEWAGE TREATMENT FACILITIES
IN THE GENESEE RIVER BASIN

COUNTY	TOTAL POPULATION (1960 Census)	POPULATION SERVED	NUMBER OF FACILITIES		FLOW MGD	BOD BASIS POPULATION EQUIVALENT		PER CENT REDUCTION
			PRIMARY	SECONDARY		INFLUENT	EFFLUENT	
Allegany	30,700	6,000	1		1.80	7,330	6,000	10
Genesee	15,500	4,800	1		0.46	4,500	2,930	35
Livingston	43,900	18,700	3	4	2.46	20,340	7,840	60
Monroe	260,000[2]	40,800	5	1	3.17	32,000	19,000	41
Wyoming	19,400	3,650	1		0.34	4,350	2,830	35
TOTALS	370,000	69,150			8.28	68,520	37,700	

1 Waste water contribution from the remaining counties were considered insignificant, since such a relatively small portion of these counties lie within the hydrologic basin.

2 Most of the waste collected in Monroe County within the Genesee River Basin is treated at the Rochester Sewage Treatment Plant and discharged to Lake Ontario.

Within Livingston County there are seven facilities that serve 20,900 of the County's 43,900 population; these seven plants provide about 60 percent treatment.

Wyoming County has a total population of 19,400 of which about 3,650 are served by the treatment facility at Warsaw.

Monroe County has a large population, 260,000, residing in the Genesee River Basin, but only a fraction of this is served by facilities discharging to the basin waters. Most of this population is served by the Rochester City sewage treatment plant which discharges directly to Lake Ontario. The six plants in the County, which serve more than 40,800 of the combined population, treat about 41 percent of the waste received.

A municipal waste inventory of the major communities is given in Table IV-2. Two of the communities listed, Geneseo and Honeoye Falls, have secondary treatment facilities. The plant at Geneseo, built in the last five years with a capacity more than double the present loading, is the only adequate plant in the basin. The plant at Honeoye Falls operates at better than 80 percent efficiency, but to date has been overloaded by waste from a dairy processing plant.

The other eight discharges listed are from plants effecting primary treatment, except those of the villages of Perry and Avon. The village of Avon has an antiquated plant that provides extremely poor treatment and cannot be considered, on the basis of BOD reduction, a treatment facility. The village of Perry has no treatment facilities. The Town of Irondequoit has two primary facilities discharging to the Genesee River, both of which are operating inefficiently. New secondary treatment facilities are under construction at the North St. Paul Street Plant, and pumping facilities are being constructed at the Summerville Plant to transport its waste to the enlarged North St. Paul Street Plant.

By 1980 the total waste load treated by municipal plants is projected to reach 30,000 pounds of BOD_5 per day, by 2020 this raw production will have risen to 58,000 pounds of BOD_5 per day. These figures assume that by 1980 the total municipal population in communities over 500 population will be served

Table IV-2

SIGNIFICANT MUNICIPAL WASTE DISCHARGES
IN THE GENESEE RIVER BASINS

NAME OF COMMUNITY OR FACILITY	RECEIVING STREAM	EXISTING TREATMENT	ESTIMATED POPULATION CONNECTED TO SEWERS	AVERAGE DAILY FLOW MGD	ESTIMATED SEWERED POPULATION EQUIVALENT (BOD BASIS)	
					UNTREATED	DISCHARGED
Avon	Genesee River	None	2,700	0.40	4,000 E*	4,000E
Dansville	Canaseraga Creek	Primary	5,500	0.40	3,800	2,500
Gates-Chili-Ogden (Monroe County Sewer Agency)	Genesee River	Primary	15,000	1.70	17,000	11,000
Geneseo	Genesee River	Secondary	3,300	0.50	5,000E	500E
Honeoye Falls	Honeoye Creek	Secondary	2,600	0.21	2,200	330
Irondequoit (Stutson Plant) S.D. #1**	Genesee River	Primary	5,500	0.55	5,500 E	3,600 E
Irondequoit (Summerville)***	Genesee River	Primary	3,000	0.30	3,000 E	2,000 E
LeRoy	Oatka Creek	Primary	4,800	0.50	5,000 E	3,300 E
Mt. Morris	Canaseraga Creek	Primary	3,300	0.40	3,400 E	2,200
Perry	Silver Lake Outlet	None	4,500	0.45 E	4,500 E	4,500 E
Warsaw	Oatka Creek	Primary	3,700	0.39	4,400	2,800
Wellsville	Genesee River	Primary	6,00-	1.80	7,500	6,200

* E = Estimated

** Secondary Facilities Under Construction

*** Presently being converted to pumping station; waste water will be transported to reconstructed Stutson Street Plant.

by sewage treatment facilities. With an 85-90 per cent treatment efficiency in terms of BOD_5 reduction, the discharged load should be approximately 4,500 pounds of BOD_5 per day in 1980, or about 30 per cent of the present municipal discharge. With 90 per cent or better treatment efficiency attained by 2020, the discharged BOD_5 load would be approximately 5,800 pounds per day or 40 per cent of the present municipal discharge.

Projection of municipal waste is based on population projections for 1980 and 2020. Raw waste loadings are based on the assumption that the population served will increase at the same rate as the projected population except for Monroe County which is expected to be fully served by 2020. Areas with population of less than 500 and presently not being served by a sewage system were considered to be too small to finance a sewage project.

C-Industrial Waste (Separately Discharged)

There are at present 16 industries separately discharging significant amounts of wastes to the waters of the Genesee River Basin. At present these industries are discharging some 85,000 pounds of BOD_5 per day and a large quantity of suspended solids in a waste flow of more than 30 MGD.

Table IV-3 lists the 16 significant industrial discharges. The Eastman Kodak Company removes about 20-25% of BOD_5 from their raw waste with primary treatment. The effluent from this plant carries approximately 53,500 pounds of BOD_5 daily to the lower Genesee River.

Curtice Burns at Bergen effects treatment of its 7,000 pounds BOD_5 per day raw waste with spray irrigation. The other major waste producers, Curtice Burns at Mt. Morris, General Foods - Birdseye Division at Avon, and Perry Knitting at Perry are major industrial waste dischargers that provide no treatment.

Most of the industrial waste produced in the Rochester Area is collected in the City's sewerage system and discharged to Lake Ontario after treatment at the City's sewage treatment plant.

Projections of industrial waste loads were made utilizing industrial waste

Table IV-3

SIGNIFICANT INDUSTRIAL WASTE DISCHARGES
(Industries Discharging Separately)

Genesee River Basin

NAME LOCATION	RECEIVING STREAM	EXISTING TREATMENT	WASTE EFFLUENT MGD	WASTE EFFLUENT #BOD_5/DAY
Ainsbrook Corp. Warsaw	Oatka Creek	None	0.04	200
Birdseye Avon	Genesee River	Vibrating Screens	1.00	16,700 (1)
Borden's Food Co. Whitesville	Cryder Creek	Septic Tanks	0.08	50 E
Conesus Milk Products Lakeville	Conesus Outlet	None	0.22	50 E
Conesus Milk Products Nunda	Keshequa Creek	None	0.03	50
Curtice Burns Bergen	Black Creek	Vibrating Screens Spray Irrigation	0.54	760 E[1]
Curtice Burns Mt. Morris	Genesee River	Vibrating Screens	0.36	10,000 [1]
Dairymen's League Groveland	Canaserga Creek	None	0.01	50 E
Eastman Kodak[3] Rochester	Genesee River	Primary (20-25%)	26.00	53,500
Foster Wheeler Dansville	Canaserga Creek	Septic Tanks	0.34	270 E
Friendship Dairies Friendship	Van Campen Creek	Leach Field	0.05	50 E
Lapp Insulator LeRoy	Oatka Creek	None	0.18	(4)
Le Roy Elm Dairy LeRoy	Mud Creek	None	0.02	50 E
Lucidol Chem	Genesee River via Trile	None	0.08	(5)
Perry Knitting Perry	Silver Lake Outlet	None	0.13	1,700 E[2]
Sunnydale Farms Andover	Dyke Creek	None	0.04	50 E

E=Estimated

[1] Discharge results from processing water from July through November, otherwise operations results in minimal discharges in conjunction with packaging operations.
[2] Transaction in progress for acquisition of Company by Charles Pindyck, Inc.; operations presently reduced.
[3] New secondary treatment facilities under construction.
[4] Discharges large quantities of suspended solids.
[5] Discharges untreated chemical wastes

water indices and holding concentrations constant. Past trends in employment in each major water using industry, employment projections in such industries, and water use per employee projections were used to arrive at the indices.

By 1980 industries with separate discharges are expected to produce 160,000 pounds of raw BOD_5 per day with a flow of 43 MGD. With the recommended 85-90 per cent treatment in effect at that time, the discharged waste should total about 24,000 pounds of BOD_5 per day or less than 30 per cent of the present load from separately discharging industries. By the year 2020 production of waste by these same industries is projected to be approximately 250,000 pounds per day of BOD_5 at a flow of 69 MGD. With an anticipated 90 per cent or better treatment in effect, the discharge load should be approximately 25,000 pounds of BOD_5 per day or less than 30 per cent of the present load.

Figure IV-1 is a presentation of the projected total loading (where loadings are in close proximity, they are considered as one discharge) to each stream sector below a significant municipal and/or industrial discharge or series of discharges. Also shown is the fraction of the total loading that industry will contribute.

The Genesee River will receive in 1980 and 2020 approximately 90 per cent of the total municipal and industrial waste loading in the basin. This represents approximately the same distribution pattern of present discharges. The other remaining streams in the basin receive only ten per cent of the entire loading; however, this loading will be sufficient to create serious pollution problems in streams which have low flows during dry summer months.

The largest point discharge for 1980 and 2020 in the basin will be in the lower Genesee below Kodak. Assuming 85-90 per cent treatment of Kodak's waste production in 1980 and 90 per cent or better in 2020, the effluent loading to the stream will range between 16,000 and 18,000 pounds of BOD_5 per day. Other significant stream sector loadings include the Genesee River below the Gates-Chili-Ogden treatment plant discharge and the Genesee River below the combined Avon-Birdseye discharge.

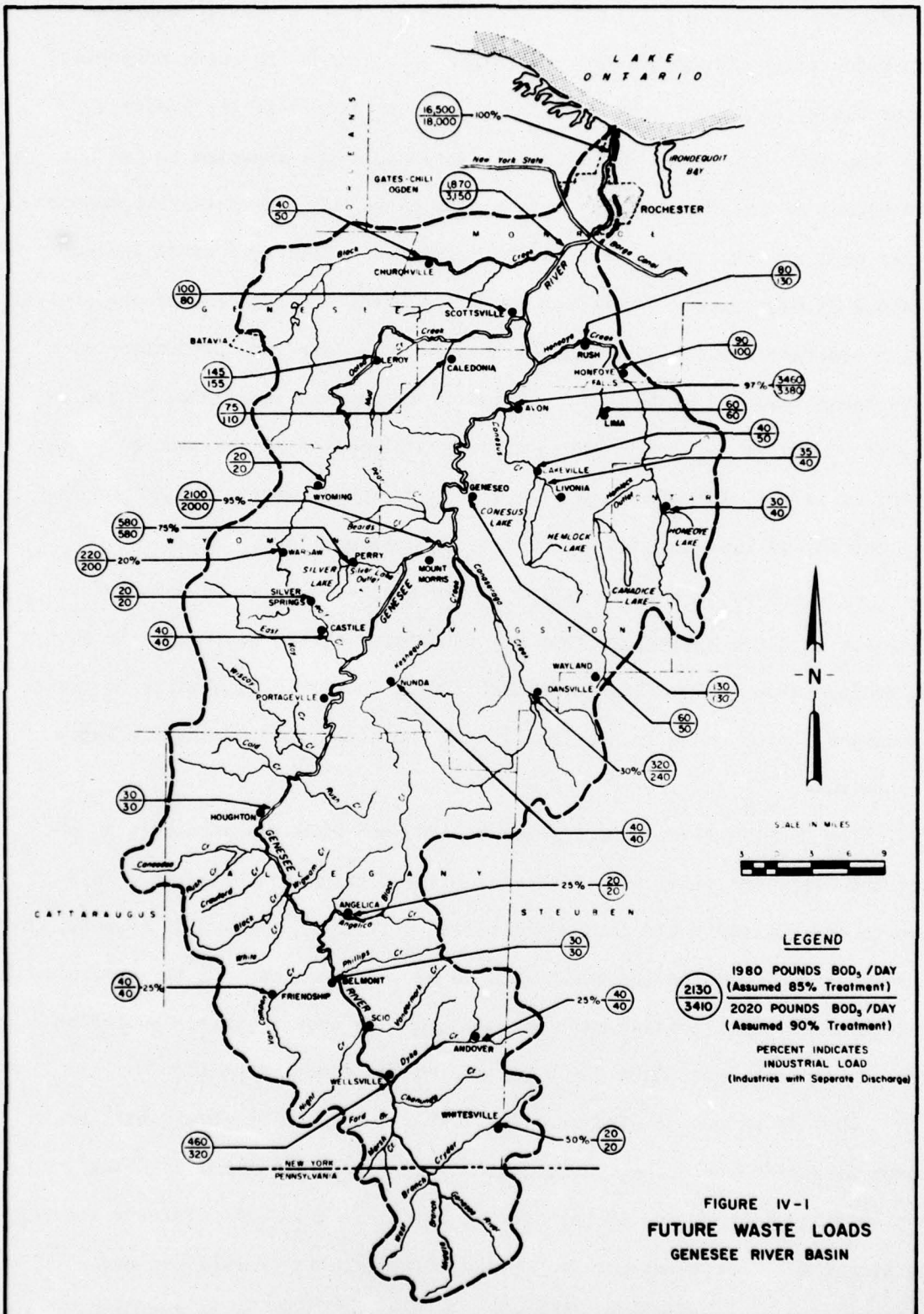


FIGURE IV-1

FUTURE WASTE LOADS

GENESEE RIVER BASIN

D-Combined Sewers

It has been estimated that a quantity, equivalent to three to five percent of all raw waste water flow in combined sewer systems, is annually discharged to streams through overflows (5). It is also estimated that a far greater percentage of the solids are discharged to streams from overflows, due to the fact that deposits of sludge built up in the sewers is flushed out during periods of storm flow.

Combined sewer overflows are a major source of pollution in the Rochester area. The City of Rochester sewer system is 75 percent combined. Thirty possible overflow points from the City's system exist in the lower twelve miles of the Genesee River. The City embarked on a sewerage improvement program in the late 1950's at an estimated cost of 18 million dollars. This program included new treatment facilities and reinforcement of the collection system to reduce the overflows to the Genesee and Irondequoit drainage basins. The improvements to the collection system have increased the average inflow to the treatment plant from 70 MGD to 95-100 MGD. The average water use of the consumers contributing to the sewage plant is approximately 50 MGD. The outfall pipe was originally designed for 180 MGD. Replacement of a section of the original pipe with a large diameter pipe has increased the original design capacity. Flows in excess of 180 MGD which surcharged the outfall pipe have been experienced.

The City maintains a minimum of bi-weekly surveillance of its regulating devices at the points of overflow, and has reported that there are no overflows during periods of dry weather (6).

E-Phosphates

Each of the sources of waste cited previously in this chapter is a cause of phosphate pollution. Such pollution is known to cause excessive production of algae which in turn decay and exert a serious demand on the oxygen resources in lakes and streams. The algae also cause an unsightly appearance,

odor, interference with water treatment processes, and other nuisances.

Major sources of phosphate in the basin are domestic and industrial waste discharges and agricultural land runoff. Domestic sewage is rich in phosphorus compounds. The amounts of phosphorus released by human metabolic processes is a function of protein intake and for the average person in the United States, this release is considered to be about 1.5 grams per day (7). Synthetic detergents in domestic sewage also contain large amounts of phosphorus, an estimated 2.5 grams per capita per day. Using the total population served by municipal collection systems as a basis, approximately 80,000 people, the total amount of phosphorus produced by domestic waste discharges is about 225,000 pounds per day. The amount of phosphorus actually discharged is estimated to be only a fraction less than the total produced. This is an assumption based on the fact that most plants in the basin are of the primary type and the removal of phosphorus with this level of treatment is known to be minimal.

Data from sampling stations at the mouths of the major tributaries of the Genesee River and in the river itself just upstream of its entrance to Lake Ontario revealed significant quantities of phosphorus (as soluble phosphates). The results are summarized in Table IV-4.

Table IV-4

Phosphate Loadings in Major Streams
Genesee River Basin
(1964 - 1965 Sampling Data

Stream	Miles above Mouth	No. of Samplings	Soluble Phosphate as Phosphorus mg/l.	LBS./YEAR
Genesee River	2.0	9	0.10	321,660
Black Creek	2.8	3	0.08	1,660
Oatka Creek	1.4	3	0.13	5,660
Honeoye Creek	2.0	2	0.27	1,000
Canaseraga Creek	1.1	3	0.14	15,830

As shown, about 321,660 pounds per year of soluble phosphates as phosphorus was found discharging to Lake Ontario. The difference between

this total and the estimated contribution from domestic waste can be attributed mostely to land runoff, and to a lesser extent to industrial discharges. A study of runoff as a source of phosphate in the waters of streams and lakes (8) revealed the average amount of soluble phosphate reaching streams from land runoff in the Lake Michigan Basin to be approximately 0.1 pounds per acre of watershed. Assuming similar land management practices and runoff characteristics in the Genesee Basin, the amount of soluble phosphates as phosphorus would be 50,000 pounds per year.

It should be noted that agricultural and land runoff in general constitute a significant source of pollution. An estimated 400,000 pounds of pesticides were applied to the basin in 1965, mostly in the form of DDT, Polygram, and Antazine. About 10,000 tons of phosphate from fertilizers and livestock were applied to the basin as measured in 1959.

Chapter V

FLOW CHARACTERISTICS INCLUDING TIME OF TRAVEL STUDIES

A-Introduction

The United States Geological Survey prepared reports on Duration, Frequency and Distribution of Streamflow in the Genesee River Basin with Emphasis on Low Flows; and Time of Travel Studies: Genesee River Basin. The summary and conclusions from the first report and the summary and Table V-1, Time of Travel Data, from the second report are of significance to this study and are included herein.

B-Summary and Conclusions of Streamflow Report

As part of its responsibility in the comprehensive study of the Genesee River Basin, the U.S. Geological Survey furnished new and existing data on a continuing basis as requested by other agencies.

Data have been collected for streams and lakes in the Basin for periods ranging up to 60 years. Records for the principal measurement sites have been summarized by Gilbert and Kammerer (1965) and, together with the new information collected during 1964 and 1965, form the basis for the information presented in this report. By processes of correlation, the shorter streamflow records have been extended to a standard period, 1931-60, to allow comparison among streams on an equivalent basis for duration and frequency analyses.

Studies of runoff for the standard period 1931-60 indicate average annual runoff ranges from 10 to 20 inches over the Basin, producing an overall average figure of about 14 inches. Average annual runoff is consistently about 20 inches less than precipitation throughout the basin.

A generalized map was constructed to show the areal distribution of average low flows for a 7-day period having a 2-year recurrence interval. This map was based on a reconnaissance of the Basin when duration of streamflow was generally between 95 and 99 per cent and supplements data from the low-

flow frequency analyses. During the reconnaissance, streamflow conditions ranged from no flow at many locations to almost 3.0 cfs per square mile for Spring Creek at Mumford, New York.

In addition to the studies mentioned above, monthly and seasonal duration hydrographs, base-flow recession curves, and draft-storage frequency curves were developed for various groups of selected gaging stations.

Sufficient data were available for the construction of a profile of duration of flow for the Genesee River which facilitated estimates of discharge for selected durations along the stream.

There are many streams in the basin which have sufficient discharge at all times of the year to supply large quantities of water on a steady basis. Other streams require that storage facilities be provided to augment periods of low flow, and some streams are almost entirely inadequate for development as water supplies.

At this time, a large amount of information is available to aid in the planning for best use of the surface waters of the basin. However, it is necessary to be aware that the extrapolation of low-flow data from a gaged to an ungaged site is not advisable without careful study, even for points on the same stream. At least, a field reconnaissance should be made for each ungaged site to determine specific conditions in that particular locale. Some consideration should also be given to the influence of withdrawal or use of surface water on the rest of the hydrologic environment in the basin.

As yet, little can be accomplished by way of preventing droughts. Nevertheless, if sufficient analyses such as those in this report are available, water managers can do much to ease the accompanying consequences.

C-Summary of Time of Travel Report

Time-of-travel was determined for 20.4 stream miles in single reaches Canaseraga, Honeoye, and Oatka Creeks and for 15.15 stream miles in two reaches of the lower Genesee River. Three runs at various discharge rates were made in each reach.

Time-of-travel data for the reaches on Canaseraga Creek, Honeoye Creek, and Oatka Creek are depicted on a series of graphs which show time-distance relation for several discharge rates. The data for the two reaches on the Genesee River have been tabulated. However, only the data for the Genesee River upstream from the canal are summarized graphically owing to several complicating factors which affected the runs. Further studies would be required to define meaningful relations.

Flow-duration curves and minimum average consecutive 7-day discharges for a 10-year return period were determined for the gaging stations on Canaseraga Creek near Dansville, Genesee River at Driving Park Avenue, Rochester, Honeoye Creek at Honeoye Falls, Oatka Creek at Warsaw, and several other streams with long term records.

To facilitate future studies of stream pollution mechanics, considerable information from discharge measurement notes and from fluoroemeter operations are included in appendices.

Table V-1--Time-of-travel data, Genesee River basin

Stream Site Identification	Reach or Subreach: Initial Point	Reach or Subreach: Terminal Point	Mileage	First Run: Date	First Run: Discharge (cfs)	First Run: Time	First Run: Velocity (fps)	Second Run: Date	Second Run: Discharge (cfs)	Second Run: Time	Second Run: Velocity (fps)	Second Run: Mean depth	Third Run: Date	Third Run: Discharge (cfs)	Third Run: Time	Third Run: Velocity (fps)	Third Run: Mean depth
Canaseraga Creek Dansville	Dansville State Hwy.245 (19.3)	Dansville State Hwy. 36 (18.3)	1.0	5/13/65	86	0:55	1.60	6/15/65	31	1:25	1.04	0.7	9/ 8/65	15	2:15	0.65	—
	Dansville State Hwy. 36 (18.3)	White Bridge (16.35)	1.95	5/13/65	86	1:30	1.91	6/15/65	31	2:40	1.07	.9	9/ 8/65	15	4:00	.72	—
	White Bridge (16.35)	Everman Road (15.25)	1.1	5/12/65	93	1:45	.92	6/15/65	31	3:15	.50	1.2	9/ 8/65	15	5:35	.29	—
	Everman Road (15.25)	West Sparta Station (14.25)	1.0	5/12/65	93	:45	1.96	6/15/65	31	2:00	.73	1.0	9/ 8/65	16	2:15	.65	—
	West Sparta Station (14.25)	No Bridge Road (12.5)	1.75	5/12/65	96	2:10	1.18	6/15/65	30	3:55	.66	1.0	9/ 8/65	16	6:00	.43	—
	No Bridge Rd. (12.5)	Groveland State State Hwy.258 (11.0)	1.5	5/12/65	96	2:20	.94	6/15/65	30	4:35	.48	1.6	9/ 8/65	17	8:55	.25	—
	Groveland State Hwy.258 (11.0)	Groveland E-L RR bridge (9.9)	1.1	5/12/65	96	2:15	.72	6/15/65	30	4:10	.39	1.8	9/ 8/65	17	7:00	.23	—
Honeoye Creek Honeoye Falls	Honeoye Falls STP outfall (14.0)	L.V. RR bridge (13.3)	.5	5/11/65	83	:55	.84	6/ 2/65	25	2:00	.37	—	9/ 9/65	2.8	11:30	.06	1.1
	L.V. RR bridge (13.5)	Sibley Road (12.4)	1.1	5/11/65	83	1:35	1.02	6/ 2/65	25	4:20	.37	—	9/ 9/65	2.0	20:45	.08	.6
Oatka Creek Warsaw	Allen St. Warsaw (47.5)	Buffalo St. State Hwy.20A (47.1)	.4	6/ 3/65	17	:50	.70	6/17/65	6.6	1:35	.37	1.2	9/10/65	3.3	2:15	.26	1.1
	Buffalo St. State Hwy.20A (47.1)	Above ditch (46.6)	.5	6/ 3/65	17	:55	.80	6/17/65	6.6	2:00	.37	.8	9/10/65	3.3	3:10	.23	.7
	Above ditch (46.6)	Village line Road (45.8)	.8	6/ 3/65	17	4:05	.29	6/17/65	6.1	7:25	.16	1.5	9/9-10/65	3.0	12:50	.09	1.2
	Village line Road (45.8)	State Hwy.19 bridge (44.1)	1.7	6/ 3/65	20	9:45	.26	6/16-17/65	6.1	23:00	.11	2.0	9/9-10/65	2.7	38.20	.06	1.7
	State Hwy.19 bridge (44.1)	School Road Wyoming (38.1)	6.0	6/3-4/65	22	34:30	.26	6/16-19/65	5.1	80:00	.11	1.7	9/8-15/65	2.1	174	.05	1.6

Table V-1--Time-of-travel data, Genesee River basin (Continued)

Stream Site Identification	Reach or Subreach: Initial Point	Reach or Subreach: Terminal Point	Mileage	First Run: Date	First Run: Discharge (cfs)	First Run: Time	First Run: Velocity (fps)	Second Run: Date	Second Run: Discharge (cfs)	Second Run: Time	Second Run: Velocity (fps)	Second Run: Mean depth	Third Run: Date	Third Run: Discharge (cfs)	Third Run: Time	Third Run: Velocity (fps)	Third Run: Mean depth
Genesee River Rochester (Canal)	Gates-Ogden-Chili STP Outfall (13.7)	Erie (Barge Canal) West Side (11.5)	2.2	5/14/65	2,100	3:50	0.84	8/4-5/65	160	8:05	0.1	--	11/2-3/65	435	18:35	0.17	--
	Erie (Barge) Canal East Side (11.46)	Andrews St. (7.86)	3.6	5/14/65	--	8:05	.65	--	--	--	--	--	--	--	--	--	--
	Erie (Barge) Canal East Side (11.46)	Elmwood Ave. (10.96)	.5	--	--	--	--	9/21/65	930	2:00	.37	--	11/3/65	759	3:25	.21	--
	Elmwood Ave. (10.96)	Clarissa St. (9.16)	1.8	--	--	--	--	9/21/65	1,020	7:15	.36	--	11/3/65	940	11:30	.23	--
	Clarissa St. (9.16)	Court St. Dam (8.31)	.85	--	--	--	--	9/21/65	1,280	2:40	.47	--	11/4/65	1,100	5:55	.21	--
	Court St. Dam (8.31)	Andrews St. (7.86)	.45	--	--	--	--	9/22/65	300	1:00	.66	--	11/4/65	1,100	:30	1.32	--
Genesee River Kodak Park Rochester	Kodak Park STP (4.3)	Stutson St. bridge (0.75)	3.55	5/11/65	4,220	6:05	.86	--	--	--	--	--	--	--	--	--	--
	Kodak Park STP (4.3)	Seneca Park (3.0)	1.3	--	--	--	--	8/ 3/65	630	8:15	.23	--	--	--	--	--	--
	Seneca Park (3.0)	Below Rattlesnake Point (1.35)	1.65	--	--	--	--	8/ 3/65	590	6:40	.36	--	--	--	--	--	--
	Below Rattlesnake Point (1.35)	Stutson St. bridge (0.75)	.60	--	--	--	--	8/ 4/65	650	3:35	.25	--	--	--	--	--	--
	Kodak Park STP (4.3)	Below Seneca Park (2.78)	1.52	--	--	--	--	--	--	--	--	--	11/4/65	920	9:50	.23	--
	Below Seneca Park (2.78)	Rattlesnake Point (1.91)	.87	--	--	--	--	--	--	--	--	--	11/5/65	920	9:10	.14	--
	Rattlesnake Point (1.91)	Stutson St. bridge (0.75)	1.16	--	--	--	--	--	--	--	--	--	11/5/65	920	8:05	.21	--

CHAPTER VI

BASIC DATA ON SURFACE WATER QUALITY

A. Introduction

As indicated in the previous sections of this report, the surface waters of the Genesee River Basin receive varying amounts of inadequately treated industrial and domestic waste. Consequently, much of the basin waters are polluted and unsightly. In numerous locations the problems are such that many possible uses for that stream sector are impaired. It will be the purpose of this section of the report to give a capsulated account of the existing quality of the Basin waters, those that are affected by these waste loadings as well as those in their natural state. In reporting the quality of any stretch of stream, an attempt will be made to compare the determined quality against the criteria of the existing standards which are appended to this report. When demonstrable, deteriorated waters will be linked to some probable upstream waste input.

Beginning at the headwaters and continuing downstream to its mouth, the main stem and each of its major tributaries will be described separately. The results of the physical, chemical, biological, and bacteriological analyses from the 1964 and 1965 field surveys will serve as the basis for this Chapter.

B. Background

Data collection for determinations of surface water quality was undertaken in a joint effort by the New York State Department of Health and the Federal Water Pollution Control Administration (originally the U.S. Public Health Service) in the spring of 1964. Using mobile laboratory facilities situated at the Geneseo Sewage Treatment Plant,

a joint survey team sampled over 200 stream locations throughout the basin on an average of three times. Table VI-1 in the appendix lists the sampling stations and a description of each station. The index code shown in Table VI-1 for each stream is that presently used by the State Department of Health and is included to provide a reference to historical quality data presented in the Genesee River Basin pre-classification reports of 1955 and 1958.

The original survey continued in 1965 at selected stations. The emphasis shifted during the second summer to detailed stream surveys necessary for determining deoxygenation and reaeration rate constants. Only critically affected reaches were studied and these included two reaches on the Genesee, one on Oatka Creek, and one on Canaseraga Creek.

Coupled with these stream quality analyses was an extensive survey of industrial discharges. In the case of a few larger industries this represented an actual sampling of the outfalls; in the majority of the cases this consisted of updating the information on the Form 117's utilized by the State Department of Health.

All the data collected in the 1964 and 1965 surveys are shown in Table VI-2 in the appendix. Table VI-3 shows the results of analyses made on Lakes Conesus, Honeoye and Silver. Table VI-4 includes data analyzed on samples collected as part of the State's water quality surveillance program.

C. Genesee River - Main Stem

Originating fifteen miles south of the New York-Pennsylvania border, the Genesee River flows northward 150 miles through light residential and farmland areas and terminates at Rochester where it empties into Lake Ontario. In general its quality changes from clean water to moderately polluted, and finally, to extremely polluted water.

These three quality sectors approximate the stretch above the Falls in Letchworth State Park, the stretch from the park to the falls at Rochester, and the short stretch from the Rochester falls to Lake Ontario. The water quality of the main stem of the River will be described according to these sectors.

Genesee River above Letchworth State Park

Between the headwaters and Letchworth State Park at Portageville, the River descends nearly 530 feet in sixty-two miles. This large descent greatly enhances the natural purification ability of the River, and, as a consequence, this portion of the River experiences fairly good quality.

Upstream of Wellsville the River exhibits relatively good quality in terms of all parameters. No contravention of stream standards was found in terms of dissolved oxygen. The 15 mile stretch of River is classified as "C" to Standards Corners and as "A" to the Refinery Dam at Wellsville. It is used extensively as a trout stream and as the source of Wellsville's water supply.

At Wellsville, the River receives significant quantities of untreated industrial waste plus the effluent from the village's over-loaded primary treatment plant which serves about 6,500 people. Of the three surveys conducted in 1964, the July results showed the greatest degradation. The DO dropped from a high of 9 mg/l above Wellsville to 6 mg/l two miles downstream; the 5-day BOD rose from less than one mg/l to 4.4 mg/l; and the coliforms density increased from 2,300 to over 15,000. At Scio, the River began to recover with the DO reaching 7.4 mg/l and the 5-day BOD dropping to 3.6 mg/l. The river flow during this period was only 23 cfs, just three cfs greater than the minimum seven consecutive day discharge. Nitrogens and phosphates were measured on one occasion just below Wellsville. These measurements showed high phosphate concentrations and very negligible inorganic nitrogen,

indicating that nuisance algae blooms probably do not occur in the stream at this location; a biological survey in 1965 confirmed this conclusion. The quality of the water in the stretch immediately below Wellsville appears to be relatively good and does not contravene its Class C standard in terms of DO.

Between Scio and Portageville the river recovers its original headwater quality and easily meets its Class C standard. The flow is swift through most of this 40 mile reach because of a favorable slope of nearly ten feet per mile. As a result, the raw sewage from Belmont's 1,200 residents and the small milk plant discharges at Belmont and Houghton cause no gross pollution effects. The 1964 summer survey revealed that the 5-day BOD remained near 1 mg/l. The DO remained near saturation except for one occasion in July of that year for the stretch immediately downstream of Belmont when a value of 6.2 mg/l was recorded. Observations of bottom fauna indicated that the organisms were predominantly of the clear water variety, mostly caddisflies and mayflies.

Genesee River between Letchworth State Park and Rochester

The first part of this sector, known as the Letchworth Gorge and part of the Letchworth State Park, flows over a series of falls to the Mt. Morris Flood Control Dam, dropping more than 500 feet in 20 miles. The stream is classified as a B stream throughout this area. Except for some nuisance algae conditions in the Mt. Morris Dam impoundment, the quality of the water is good and there appears to be no contravention of standards in terms of DO. However, high conductivities and chloride concentrations were found just upstream of the dam. The cause of this situation can be traced to Wolf Creek, a salt laden tributary of the Genesee River, containing chloride concentrations of 3,000 to 6,000 mg/l and conductivities of 9,800 to 15,750 micromhos/cm,

before entering the Genesee River between Portageville and Mt. Morris.

Below the Mt. Morris Dam the river opens into a broad alluvial plain and the flow becomes sluggish. This plain extends for 50 to 60 miles to Rochester and the river bed slopes only about one foot per mile. However, its flow nearly doubles in volume from a minimum seven consecutive day value of 70 to nearly 120 cfs; most of the increased flow is due to the input of four main tributaries - - Canaseraga, Honeoye, Oatka, and Black Creeks.

At Mt. Morris the river receives great quantities of untreated wastes from the Curtice Burns, Inc. Cannery between the months of July and November. The July 1964 survey revealed the cannery to be discharging nearly 9,000 pounds of 5-day BOD and to be reducing the river DO from nearly 7 mg/l above the outfall to 4 mg/l below the outfall. The river flow at the time of sampling was nearly 135 cfs; the minimum seven consecutive day flow past this point is about 70 cfs. It is anticipated that the DO in the stream falls below 4.0 mg/l during periods of low flow causing contravention of DO standards.

Six miles downstream of the cannery discharge and two miles below the Canaseraga Creek confluence, the river still exhibited signs of gross pollution. The DO at this point, the Jones Road Bridge Crossing, had risen to only 4.6 mg/l.

The biology of the stream begins to change below Mt. Morris. The stream organisms begin to reflect conditions typical of an organically enriched stream. Benthic fauna typical of a zone partially polluted or in a transition stage, Isopods (aquatic sow bugs), Sphaeriididae (fingernail clams), and Tendipedidae (blood-worms), were found to predominate. Clean water organisms that completely dominated upstream sectors still persisted, but in fewer numbers. Attached algae indicating nutrient rich waters also began to appear in significant quantities below Mt. Morris.

STREAM	STORET NUMBER	RIVER MILES	ORGANISM: SPRING PHASE CLEAN WATER	SPRING PHASE TRANSITIONAL	SPRING PHASE PT*	SPRING PHASE ATT. ALGAE	SUMMER PHASE CLEAN WATER	SUMMER PHASE TRANSITIONAL	SUMMER PHASE PT*	SUMMER PHASE ATT. ALGAE
Genesee River	3154	110.5				-				
Genesee River	3143	106.7				-				
Genesee River	3142	88.8				C				
Genesee River	3144	67.0				C				C
Genesee River	3102	34.7				S				S
Genesee River	3101	14.0								C
Genesee River	3100	9.0				C				C
Genesee River	3110	5.0								O
Genesee River	3109	2.0				O				O
Genesee Harbor (144-a)		0.0								
Barge Canal - 5	3108									
Canaseraga Creek	3107	1.1								U
Honeoye Creek	3105	12.4				O				
Honeoye Creek	3106	1.4				O				S
Oatka Creek	3104	1.0				C				O
Black Creek	3103	2.8				S				S

NOTE: C = Cladophora O = Oscillatoria S = Sphaerotilus U = Ulothriv *Pollution Tolerant

Table VI-5 BENTHIC FAUNA & ATTACHED ALGAE OF GENESEE R. & MAJOR TRIBS. - 1965

As shown in Table VI-5, the predominant organism found in this stretch was Cladophora.

At Geneseo, 15 miles further downstream, the river still appears to be experiencing the effects of the cannery discharge at Mt. Morris. In October, 1964, the time of maximum cannery production, sampling data revealed a 5-day BOD of 6.6 mg/l and a DO of about 70 percent saturation. There are no other sizable upstream discharges that could have caused this high loading. The river flow during October averaged about 120 cfs. The Geneseo sewage treatment plant is the only adequate plant (secondary treatment) on the Genesee River and the impact of its effluent was found to be negligible.

Continuing downstream to Avon, the stream maintains about the same flow and improves in quality. The chloride concentration in July, 1964, was nearly 100 mg/l due largely to the salts from Wolf Creek. At Avon, the river is the recipient of more cannery wastes and the effluent from the village's highly overloaded primary sewage treatment plant. The total 5-day BOD from the Birdseye Division of General Foods, Inc., cannery has been estimated at 17,000 pounds per day. A sampling of the river near this discharge in September of 1965 revealed a 5-day BOD of 15.0 mg/l, and a DO of only 5.0 mg/l at 14.0 ^{o}C. New York State records of previous years indicate the river is usually polluted during the summer and fall months in this reach below Avon; the"Genesee River Drainage Basin, Survey Series Report No. 2", stated that recovery was not effected until 15 miles downstream of Avon. Fishkills have often occurred in this stretch with one of massive proportions reported in 1959. The stream classification for the river above and below Avon is "C"; stream standards are contravened in this stretch.

The 1965 survey indicated a large increase in total nitrogens, particularly nitrates. Nitrates measured 1.4 mg/l in July of 1965 and

0.5 mg/l in September of 1965, coupled with phosphate concentrations of 0.5 mg/l or more. These nutrient levels are contributing to the large phytoplankton populations found in this sector and further downstream.

The stream biology below Avon indicated a further deterioration of quality. Organisms tolerant to gross pollution began to appear in large numbers and clean water organisms completely disappeared (Table VI-5). Such organisms as Oligochaeta (sludge-worms), Tendipedidae (bloodworms), and Hirudinae (leeches) were found in addition to the transitional variety described as dominant below Mt. Morris. Sphaerotilus, a periphytic bacteria, commonly found below waste discharges, was abundant.

In the next twenty miles, the river gradually recovers from its severely polluted condition at Avon. Very little waste is added to the river in this stretch. Oatka, Honeoye, and Black Creeks, three of the river's four largest tributaries, enter the river in these twenty miles. The waters emanating from these streams do not appear to have a significant effect on the quality of the river water. At a station below the Honeoye Creek confluence (Route 251 Bridge Crossing) the river exhibited only moderate pollution. During the summers of 1964 and 1965, conductivities and chloride concentrations remained high, but the DO increased above the critical values found below Avon and the 5-day BOD's stabilized at 2 - 3 mg/l. At a point just downstream of the Oatka Creek confluence (Route 253 Bridge Crossing), the river remained in this moderately polluted condition.

About three miles upstream of the Barge Canal junction, the river receives the discharge from Black Creek and the effluent of the Gates-Chili-Ogden primary sewage treatment plant. June and September 1964 data, from stations just above and below Black Creek at the Ballantyne Road and New York Central Railroad Bridges respectively,

reflect little effect on the river's water quality from the creek. The sewage treatment plant discharge contributes an appreciable organic loading, estimated to be nearly 2,000 pounds per day of 5-day BOD. The river exhibits a moderate DO deficiency or sag in the reach downstream. Summer 1965 data from intensive studies of the river below this discharge revealed 5-day BOD's of 3 - 6 mg/l and DO's as low as 4.0 mg/l. Ammonia concentrations in the plant's effluent averaged 30 mg/l but less than 1.0 mg/l in the river after dilution.

Below the confluence with the Barge Canal and extending to the series of natural falls in Rochester the river appears to improve slightly in quality. The DO remains high and only occasionally does the BOD rise to about 4 mg/l. The river quality undoubtedly fluctuates with the change in flows effected by the release of water from the Barge Canal. Biologically, the section of the river above the Barge Canal junction exhibited gross pollution. Only pollution tolerant and transition type organisms were found, similar to the situation below Avon. However, as shown in Table IV-5, the stream recovers somewhat downstream of the Barge Canal as indicated by the lack of pollution tolerant organisms in the spring. In the summer, the type of organisms indicating gross pollution are found clear down to the lake affected waters at the mouth of the river.

Coliform counts were measured in the river just above and below the Barge Canal junction in both the 1964 and 1965 surveys. Coliform counts of 2,300 to 3,900 organisms (Most Probable Number) were observed below the junction from July to October of 1964. In 1965 the results were similar. The river section between the confluence of Oatka Creek and the falls at Rochester is classified as "B". These coliform counts could have been caused by either inputs from storm water overflows along

the river banks or by ineffective chlorination at the Gates-Chili-Ogden sewage treatment plant.

Rochester to Lake Ontario

In the last six or seven miles below the falls at Rochester, the river is subjected to the most severe pollution inputs and, as a result, is in its most serious state of degradation. Near the beginning of this stretch, the river receives the industrial effluent of the Eastman Kodak Works with an organic loading of 55,300 pounds of 5-day BOD after primary treatment. Upstream of the discharge, the DO was generally greater than 70 per cent saturation and had a 5-day BOD of less than 5 mg/l. During the summer and fall of 1965, studies of the assimilative characteristics of this stretch of river revealed complete oxygen depletion beginning one mile downstream of the outfall and extending to the Lake Ontario waters. Five-day BOD's in the river were generally greater than 20 mg/l downstream of the discharge and never decreased to less than six or seven mg/l at the Lake confluence. Nitrates from this discharge ranged between 10 and 30 mg/l. In the one to two miles above its confluence with the Lake, the river has been observed to be in a septic condition.

From the falls to the Lake, the only organism found in significant numbers was the oligochaete or sludgeworm. The numbers of these organisms ranged from 8,000 to 43,000 per square meter. The phytoplankton population was also extremely high in this lower reach. In October of 1965, algal production increased from less than 2,500 organisms/ml just below the falls to more than 8,000 at the river mouth. These counts were dominated by the diatom Cyclotella and the blue-green Oscillatoria, especially indicative of heavy organic loading.

Coliform densities in this lower six or seven miles of the main stem were found to have an MPN of 760,000 in October 1964. Lower counts of 35,000 and 143,000 were recorded in July of 1964. These and other occasional high counts are generally attributable to the numerous storm water overflow outlets to the river at Rochester.

D. Major Tributaries of the Genesee River

Dyke Creek

In considering the tributaries of the Genesee River, and beginning at the river's headwaters, the first significant stream encountered is Dyke Creek. This Creek has only about 70 square miles of drainage area, is about 15 miles long, and has only one concentration of population, that being at Andover. Its flow at Andover during the July and September, 1964, surveys was less than 5 cfs. These surveys reflected a stream of fairly good quality with two exceptions. On one occasion in July the DO dropped to 3.2 mg/l below Andover and did not increase in the six to seven miles to the main river at Wellsville. In September a coliform MPN of 7,500 was found below Andover. A combination of low flow, the pollution from Andover's 1,200 residents, and a milk products plant discharge evidently caused this deterioration in quality.

The stream is classified "D" in its last mile at Wellsville, "C" to Andover, and "D" in its headwaters. No contraventions of the standards in terms of DO were found during the 1964 surveys.

Van Campen Creek

Van Campen Creek is another of the small tributaries of the Genesee River. About ten miles long, it drains 60 square miles and produces an average flow of 15 cfs.

Data from samples collected in the summer of 1964 indicated that the stream was of good quality above the Village of Friendship. The Village which has a population of 2,000 and a dairy below the Village degrades the stream appreciably; however, the stream recovered adequately before mixing with the waters of the Genesee River. Five-day BOD's in the stream rose to 21 mg/l below the Village and dairy outfall in July while the DO decreased slightly but recovered to saturation values before reaching the river. Coliform counts of 45,000 organisms (MPN) were found below the Village but decreased to less than 200 in two miles.

Classified "D" over its entire length, Van Campen Creek was not found to be contravened in terms of DO during the time of the survey.

Angelica Creek

Another of the small tributaries to the Genesee River, Angelica Creek drains 84 square miles and its waters are of relatively good quality. Angelica is the only population concentration which appears to contribute any significant pollution to the Creek.

July and September, 1964, data from samples taken at a point 1/2 mile above its confluence with the river indicated that the water was of good quality. Although the flow averaged less than 10 cfs during this period, no contravention of its "D" classification, in terms of DO, was detected during the survey.

Caneadea Creek

Relatively free of any pollution sources, the waters of this tributary to the Genesee River are of good quality. Within the 61 square mile drainage basin is a large 600 acre reservoir, Rushford Lake, used to supplement river flows during periods of peak power demand downstream.

Data collected in the summer of 1964 reflected the stream's good water quality just prior to its discharge into the Genesee River. The DO was at saturation; the 5-day BOD below 1 mg/l; chlorides below 4 mg/l; total nitrogens less than 1 mg/l; and a coliform count of 2,300 organisms (MPN).

East Koy and Wiscoy Creeks

These creeks originate in south-central Wyoming County and flow generally south to Wiscoy. At Wiscoy they merge and flow easterly to the Genesee River near Rossburg.

There are no significant sources of waste discharges to these creeks, and the natural runoff appears to have no adverse effect on water quality. They are two of the most popular trout streams in the basin and are classified "C (T)". Five-day BOD's were reported less than 2 mg/l, and DO's ranged from 8 to 12 mg/l in 1964.

Wolf Creek

From its headwaters in Wyoming County, Wolf Creek flows southerly into Letchworth State Park and joins the Genesee River at Portage.

Downstream of Silver Springs, the effects of salt manufacturing were reflected in all samples collected during the 1964 surveys. The stream had very high concentrations of chlorides, 4,000 to 6,000 mg/l, and conductivities well over 15,000 micromhos/cm. At Castile, raw domestic sewage from a population of 1,150 grossly pollutes the stream. In addition to the continuing high chloride concentrations and conductivities, a coliform count of 1,500,000 organisms (MPN), and total solids of 6,520 mg/l were reported.

Silver Lake Outlet

Silver Lake Outlet is a seven to eight mile precipitous stream descending more than 200 feet as it passes through the village of Perry, population 5,000, and Letchworth State Park.

The stream's headwaters, Silver Lake, are of good quality and used for domestic and industrial water supplies by many surrounding communities including Mt. Morris and Perry.

Silver Lake Outlet between Silver Lake and the village of Perry receives little waste discharge. In the 1964 summer investigations, slightly low oxygen values and correspondingly high 5-day BOD's were encountered. These were attributed to the heavy weed growths lining this shallow, slow moving, marshy stretch of stream.

As the outlet passes through Perry it changes to a turbulent cascading stream and continues in this way until reaching the Genesee River. Despite this naturally afforded reaeration and ability to assimilate wastes, the stream is polluted from the domestic and industrial wastes discharges in Perry. Two outfalls discharge the entire raw sewage flow of Perry's 5,000 residents to the stream, and a knitting mill and a milk plant discharge more than 2,300 pounds of 5-day BOD of untreated wastes just downstream.

Two miles downstream from Perry, near the point where the stream enters Letchworth State Park, the following data were obtained in the summer of 1964:

Maximum 5-day BOD of 8.4 mg/l, DO's of 5 mg/l, conductivities of 400 micromhos/cm, and coliform counts of nearly 43,000 organisms (MPN).

The stream improved greatly as it passed through the park. Data from the same investigation revealed the 5-day BOD had dropped to below 1.0 mg/l (except for an October sampling when the flow was low); the DO had reached saturation; and the coliform count had dropped to 2,300 organisms (MPN). The total nitrogen concentration, however, had risen considerably and heavy plankton counts were reported in the Genesee River below the outlet.

Canaseraga Creek

With its headwaters south of Dansville, Canaseraga Creek begins its forty-three mile run to the Genesee River in a relatively unpolluted condition. Its drainage basin of 340 square miles is able to supply a minimum of 20 cfs at its mouth, even during periods of low flow.

After receiving the primary treated waste of Dansville's 6,000 residents and some industrial waste, the stream quickly changes character. Above these waste inputs the stream exhibited 5-day BOD's of one mg/l or less and coliform counts of 1,000 organisms (MPN) or less; downstream it had 5-day BOD's of greater than 5 mg/l, coliform counts of 230,000 organisms (MPN), and a tenfold increase in organic nitrogen concentrations. The DO remained near saturation in this stretch of stream and did not decrease until much further downstream, indicating perhaps, the excellent reaeration capabilities of Canaseraga Creek which drops nearly 150 feet in its last twenty miles. No contravention of the stream's "C" classification in terms of DO appeared evident during the 1964 survey.

Further downstream the oxygen demand of the organic waste of Dansville is partially satisfied, reflected by 5-day BOD's of about 3 mg/l and DO concentrations of 6 - 7.5 mg/l near Groveland. Otherwise the quality of the stream's water remains only moderately polluted except for high coliform counts during periods of low flow. At Groveland a large milk processing plant discharging untreated wastes causes high turbidity and gross discoloration in the receiving waters. The stream continues to flow toward the Genesee River in this moderately polluted condition.

About five miles above its confluence with the Genesee, Canaseraga Creek receives the polluted water of Keshequa Creek, a stream with an average low flow one-fifth that of Canaseraga Creek. August, 1964, data from a sampling station near Sonyea on Keshequa Creek indicates the poor quality of this stream:

Five-day BOD's greater than 7 mg/l; nitrate concentrations of 2.5 mg/l; phosphates of 1.8 mg/l; chloride concentrations greater than 100 mg/l (natural chloride concentrations in stream headwaters were less than 10 mg/l); conductivities of 700 micromhos/cm; and coliform counts of 750,000 (MPN). The effluent of Craig Colony's treatment plant at Sonyea and wastes from two large milk processing plants at Nunda cause this polluted condition in Keshequa Creek.

The effects of Keshequa Creek and the Mt. Morris primary sewage treatment plant, which serves 3,400 people, are clearly indicated one mile upstream from its confluence with the Genesee River. August, 1964, sampling indicated 5-day BOD's of nearly 6 mg/l; turbidities of 55 mg/l; DO of 4.0 mg/l; ammonia and organic forms of nitrogen approaching 1 mg/l; and coliform counts of 2,400,000 organisms (MPN).

Biologically, as seen in Table VI-5, Canseraga Creek exhibited moderate pollution. Surveys in the spring and summer of 1965 revealed the benthic fauna of the transitional or recovery type. Seasonal phytoplankton populations vary from 1,200 organisms/ml in April to 14,000 organisms/ml in July and generally consist of green algae - again indicative of a strong recovery zone.

Conesus Outlet

Conesus Outlet is a ten mile length of stream linking Conesus Lake with the Genesee River. Except for a short stretch of stream below Lakeville, the stream has good quality water. At Lakeville, the stream is the recipient of a milk receiving plant's raw waste effluent that degrades the stream appreciably. Lakeville has a minimal effect on the stream since it is unsewered and little of the waste from the town's 400 residents reaches the stream. Lake levels on Conesus Lake are closely guarded and, as a result, the warm weather flow in Conesus Outlet is generally less than 10 cfs. Conesus Lake has been described as the most heavily used recreational lake in the basin. The Villages of Geneseo and Avon draw their water supplies from the lake.

August, 1964, survey data from a station just downstream of Lakeville (the Route 256 bridge) showed the DO to have dropped from its 7 mg/l or more concentration above Lakeville to only 1.4 mg/l which contravenes the stream "C" classification.

Honeoye Creek

Honeoye Creek is a 34 mile length of stream that receives the regulated flow from Honeoye Lake. Near Honeoye Lake, the stream is slightly impaired by septic tank seepage. Hemlock Outlet, carrying with it septic tank seepage from the unincorporated community of Hemlock, joins the creek approximately five miles downstream of Honeoye Lake. In the twelve miles from Hemlock Outlet to Honeoye Falls there appears to be no

significant sources of wastes and the stream is of good quality.

The Honeoye Falls sewage treatment plant, serving approximately 2,500 people, discharges a poor quality secondary effluent to the Creek. The plant receives dairy processing wastes which severely overloads the facilities. Below the discharge, 5-day BOD's greater than 10 mg/l and coliform counts of one and two million organisms (MPN) were found in the stream during July and August, 1964, surveys. Complete depletion of DO in this stream sector is a common occurrence. As the creek flowed to the Genesee River, these loadings were eventually stabilized; however, west of Rush, it still exhibited significantly high concentrations of organic nitrogens, phosphates, dissolved solids, and conductivities greater than 1,300 micromhos/cm. Biological investigations in the spring and summer of 1965 are summarized in Table VI-5. Observations in Honeoye Falls and just upstream of the creek's confluence with the Genesee River indicated only moderate pollution. Clean water and transitional organisms represented the entire population of aquatic fauna.

Oatka Creek

From its source in Wyoming County, Oatka Creek flows southerly past Warsaw to LeRoy and then easterly to its confluence with the Genesee River near Scottsville. At Warsaw, the stream is polluted by metal plating and knitting mill wastes and a poorly treated effluent from the Warsaw sewage treatment plant which serves approximately 3,800 people. In September, 1964, dissolved oxygen dropped to less than 1 mg/l and 5-day BOD increased from 0.6 mg/l to a high of 25.8 mg/l. Nitrogens and phosphates increased from 0.17 mg/l and 0.2 mg/l to better than 3.0 mg/l and 12.0 mg/l respectively at this time. Biological surveys in the summer of 1965 found the stream choked with aquatic weeds - a condition aided by excessive nutrients.

From Wyoming to LeRoy the stream recovered appreciably. The DO rose sharply to 8 mg/l, and the BOD decreased to low values. LeRoy, with a population of 4,800, discharged primary treated effluent including wastes from several food processors and light industries. Coliform densities of 230,000 organisms (MPN) were reported at a station just below the village in September 1964; a severe decline in DO was found in September, 1965.

About one mile downstream from LeRoy, the stream disappears and flows underground for some three miles during dry periods. Recovery of the Creek was effected when it reappeared in the vicinity of the Circular Hill Road bridge.

Mine drainage and boiler blowdown at Garbutt and primary effluent from 1,400 persons at Scottsville are discharged further downstream. The effect on the stream is a slight reduction in DO, an increase in coliform densities, an increase in dissolved solids and an increase in conductivity from 468 micromhos/cm near LeRoy to 1,295 micromhos/cm at Scottsville. Natural purification processes restore the stream in the 1.5 miles from Scottsville to the Genesee River. Biological investigations at the lower reach of the stream revealed only moderate pollution. As shown in Table VI-5, no pollution tolerant type organisms were found. The only serious contravention found during the 1964 survey was the severe oxygen depletions below Warsaw.

Black Creek

Originating in northern Wyoming County, Black Creek flows northerly and then easterly for about fifty miles where it joins the Genesee River three miles above the Barge Canal junction. The flow in the Creek is generally low during the summer, 10 - 20 cfs, but can reach 1,000 cfs in the spring. Except for a spillway at Churchville, the flow is unregulated.

Between Bethany, the headwaters of Black Creek, and Byron, the waters are of a good quality. The first signs of pollution appear in and after the Bryon-Bergen Wildlife Refuge Swamp where decaying natural organic vegetation and treated wastes from a Bergen cannery quickly degrade the stream. In July, 1964, the DO dropped to below 3 mg/l, and the conductivity rose to nearly 1,500 micromhos/cm in this reach.

In Churchville the stream passes good quality water over a spillway. Below the spillway and for a stretch of nearly one mile, the stream receives raw domestic sewage from approximately 1,000 residents and deteriorates in quality. In July of 1964, the BOD rose considerably; the DO dropped to a critically low value of less than 3 mg/l for five miles; the conductivity remained high; the organic nitrogen concentration increased to nearly 3 mg/l; and the coliform count reached nearly 1,000,000 organisms (MPN). The waste input from Churchville Village degraded the stream for a considerable distance downstream and contravened class "C" standards.

Biological studies on the lower reach of the creek in the summer of 1965 revealed pollution tolerant organisms present in great numbers, but the stream fully recovered when it entered the Genesee River.

E. Lakes

Hemlock and Canadice Lakes have been used by the City of Rochester as a source of water supply since 1876. Watershed control is enforced by "Rules and Regulations for the Protection from Contamination of the Public Water Supply of the City of Rochester" that have been in effect since 1930. The City controls all lakeshore property fronting both lakes by ownership. Fishing and hunting are limited and controlled under a permit system administered by the City Water Bureau. Water treatment consists of screening, algae control, disinfection and fluoridation.

Conesus Lake is used extensively for recreation and water supply for the villages of Avon and Geneseo, Lakeville Water District, Conesus Milk Producers Coop. at Lakeville, and numerous private cottages. The watershed is protected from contamination by established rules and regulations but unlike Hemlock and Canadice lakes the lakefront property is privately owned and pollution more difficult to control. Disinfection is the only treatment given by the municipalities using Conesus Lake as a source of supply. Table VI-3 shows the results of lake sampling.

Honeoye Lake is the source of Honeoye Creek and it is used extensively for recreation, bathing, boating and fishing. Lakefront property, privately owned, represents a source of domestic pollution and many private cottages use the lake as a water supply. The City of Rochester considered supplementing their supply from Canadice and Hemlock Lakes in the late 1920's with water from this lake. Table VI-3 shows the results of lake sampling.

Silver Lake has been developed by private enterprise into an extensive recreational center for boating, bathing and fishing. The villages of Perry, Mt. Morris and LeRoy are authorized to use the lake for municipal water supply. Table VI-3 indicates the results of lake sampling.

Rushford Lake is an artificial impoundment owned by the Rochester Gas & Electric Corporation and used for power generation. The lake is stocked for fishing and used extensively for swimming and location for private cottages.

F. Organic Chemical Residue

The manufacture and use of organic chemicals such as insecticides, herbicides, and other agricultural chemicals have increased tremendously in recent years. These contaminants enter ground water and surface waters from runoff, accidental spillage, and inadequate treatment of industrial and municipal discharges.

Professional concern is expressed in the 1962 Public Health Service Drinking Water Standards. This standard outlines the use of carbon chloroform extract (CCE) as a practical measure of a safeguard against the intrusion of excessive amounts of potentially toxic material. This procedure uses a carbon filter for absorbing and concentrating organic chemicals from water passing through the filter. Chloroform and other organic solvents are used in the laboratory to extract the organic chemical residue. Public Health Service Standards on Drinking Water recommends limiting concentration of organic chemicals extracted by this means to 200 micrograms per liter.

The City of Rochester water supply from Hemlock Lake was selected by the Public Health Service in 1961 as part of a program to determine the water quality of selected interstate carrier water supply sources. A sample collected from September 13 to September 27, 1961, showed the presence of 50 micrograms per liter of carbon chloroform extractables. Clean surface and ground waters will usually contain only 25 - 50 micrograms per liter of carbon chloroform extractables; highly colored water may exceed this level.

The results of the sampling through a carbon filter placed on the lower Genesee River during 1964 are shown in Table VI-6.

The sample of water was passed through the carbon filter at the

rate of 1/4 of a gallon per minute. A total of 5,000 gallons of water passing through the filter was reduced because of the amount of clay that had coated the filter particles on the first run.

The organic chemical absorbed by the carbon was extracted by both chloroform and alcohol. The chloroform extract was further separated by chromatography into fractions expressed as aliphatics, aromatics, and oxygenated. The aromatics are principally the derivatives of coal tar such as benzene, toluene, xylene and nitrochlorobenzene. Many of the pesticides are found in this fraction. The aliphatics contain the straight chain petroleum type hydrocarbons whose source is usually the petroleum industry. The oxygenated fraction are generally hydrocarbons that have undergone oxidation into aldehydes, ketones and esters. Some of these compounds result from long exposure of the pollution to chemical forces and some are directly discharged into streams. The alcohol fraction generally consists of polar substances such as synthetic detergents, carbohydrates, proteins and other natural products.

The average value of the carbon chloroform extractables determined on the samples collected on the lower Genesee River were below the limit set at 200 micrograms per liter in the Public Health Service Drinking Water Standards.

Table VI-6

CARBON FILTER ANALYSIS*

Lower Genesee River (Station 4.55)

(All Values in micrograms per liter)

DATE	CCE	CAE	ALIPH.	AROM.	CME
1/24 - 2/5/64	55	88	2	14	36
7/6 - 7/11/64	143	223	23	19	93
8/16 - 8/22/64	396	289	36	36	293
9/25 - 9/28/64	166	243	17	5	128
Average:	190	212	19	19	138

* CCE - Carbon Chloroform Extractables
CAE - Carbon Alcohol Extractables
ALIPH. - Aliphatics
AROM. - Aromatics
CME - Carbon Methanol Extractables

The United States Geological Survey selected three sampling points within the basin to determine the extent of ground water and surface water contamination from the use of pesticides. The criteria for selecting the sites for the ground water sampling within the basin were as follows:

1. The well should be a dug or driven well or a shallow drilled well.
2. Permeable deposits such as sand or sand and gravel should extend from the surface to a depth equal to or greater than the depth of the well.
3. The water table should be shallow.
4. The water table sampling point should be located downgrade from the area regularly (annually or seasonally) treated with known quantities of pesticides.

A description of the selected well sites and surface water sampling points is shown in Table VI-7.

The sampling site selected in the Pike-Gainsville area had been exposed to a 2-4-D base pesticide in the spring of each of the three years prior to sampling. DDT had also been used. The farm crops produced in the area were potatoes and corn.

The sampling site selected in Caledonia had been exposed to 2-4-D pesticide yearly for fifteen years prior to sampling. The farm produce in this area was corn.

The sampling site selected in the area of West Henrietta was exposed regularly to DDT and 2-4-D pesticides. The crops produced on this land were potatoes and vegetables.

Table VI-7

SAMPLING STATIONS FOR PESTICIDE ANALYSIS

Surface Water

East Key Creek ONT 117-104-3 (11.0)
Off Shearing Rd. approx. 0.5 west of Gainsville (V)
and just downstream of ONT 117-104-3-11 b
Warsaw Quad. (K-7nw)

Christie Creek ONT 117-42 (3.9)
At culvert on Quarry Rd. approx. 0.75 miles
north of Rt. 20 Caledonia Quad. (J-8 ne)

Unnamed trib. of Genesee R. ONT 117-24a (0.7)
At culvert on Moore Rd. approx. 0.1 mile
northeast of intersection with Martin Rd.
Genesee Junction Quad. (H-9 sw)

Ground Water

AREA	QUADRANGLE	TOWN	DEPTH OF WELL	DIAMETER OF WELL	WATER-BEARING FORMATION	WELL NUMBER
Pike-Gainesville	Warsaw	Gainesville (Wyoming Co.)	20'	1¼'	Gravel & Sand	230-809-1
Caledonia	Caledonia	Caledonia (Livingston Co.)	56'	6"	Sand & Gravel	257-749-2
West Henrietta	Genesee Junction	Henrietta (Monroe Co.)	13'	36"	Sand	301-742-1

Surface water sampling points were selected in streams near each location of the well sampling site. Samples were collected on November 3, 1965.

The samples of ground water and surface water were tested for the presence of the chlorinated hydrocarbon group. This group includes the organic pesticides known as DDD, tedion, dieldrin, endrin, toxaphene, and aldrin. All samples collected in the areas described which included both ground water and surface water, proved to be negative.

The chlorinated hydrocarbon group represents the greatest potential hazard in waters. This conclusion is based on the quantity, toxicity and persistence of these materials in the environment. The New York State Health Department initiated a surveillance program in 1964 for the detection of chlorinated hydrocarbon, limiting the scope to a reconnaissance for aeral distribution and concentration. Samples collected on August 10, 1964, and March 15, 1965, from the water supply of the City of Rochester taken from Lake Ontario indicated no evidence of the chlorinated hydrocarbon group in this supply.

G. Radioactivity

The Bureau of Radiological Health Services, N.Y. State Department of Health maintain a surveillance network for fallout radioactivity in varied environmental sectors including water. Two water sampling sites are located on the Genesee River and are described:

Station No.	Location
5	Genesee River, mileage point from mouth (4.30)
75	Genesee River, mileage point from mouth (139.4) Wellsville water supply

Samples collected in 1964 at Station 5 indicated the concentrations of Strontium 90 to be less than 3 pc/l based on dissolved solids and the gross gamma concentration to be between 48 and less than 20 pc/l. The Strontium 90

concentration reported at station 75 was the same at station 5 and the gross gamma concentration even less. The reported concentrations are below the limits outlined in the Public Health Service Drinking Water Standards of 1962.

Chapter VII

EFFECTS OF FUTURE WASTE LOADS

A - Introduction

As indicated earlier in this report, economic and demographic projections forecast dramatic population and industrial growth for parts of the Genesee River Basin. Attendant with this growth, as pointed out in Chapter, IV, will be an increasing production of waste water. This chapter shows the effect of the anticipated waste discharges on the receiving waters of the basin.

Paramount in the discussion of the effects of waste loads will be the relation between the stream's natural capacity to assimilate the waste, the quality desired of the receiving stream and the gross dilution requirements of the waste loads introduced after maximum treatment of the waste is attained. In effect this chapter summarizes the necessary engineering evaluations required before determining the necessary quality improvement measures.

B - Background

Streams are capable of assimilating various amounts of wastes depending upon their flow and physical characteristics. From a regulatory point of view, it is desirable to limit the amount of wastes which a receiving stream is expected to absorb such that certain minimum criteria are not exceeded. These criteria are dependent upon the usage desired of the stream water. Standards or goals are established to limit the amount of pollution a stream can receive without contravention of desired uses. The assimilation capacity of a stream is a measure of the stream's ability to accept wastes without preempting further use of the waters. This capacity is generally determined for critical periods of low flow and high temperature.

In general, the stream's ability to stabilize organic material is measured by the amount of dissolved oxygen the stream biota utilize in consuming the wastes. This is termed biochemical oxygen demand (BOD).

This consumption of dissolved oxygen in a stream is a major factor in the process called deoxygenation. Attempting to restore the depletion of dissolved oxygen is the reverse of this process and is called reaeration. The amount of oxygen a given stream may contain at any time is dependent on such factors as the partial pressure of the oxygen in the atmosphere, its solubility, the water temperature, and the area of water surface exposed to the atmosphere. In substance, unless the stream biota are inhibited by toxic materials or the stream cannot possibly supply sufficient oxygen, the stream can assimilate a given amount of waste without adversely affecting water quality.

C - Assimilative Capacity of Streams in the Genesee River Basin

Thirty stream sectors were investigated in the Genesee River basin to determine their capacity to assimilate treated wastes. Studies were made for reaches below population concentrations greater than 500 or an equivalent loading from industry. Supporting data were gathered seasonally on the Lower Genesee River, Oatka Creek, and Canaseraga Creek to determine the deoxygenation and reaeration rates for these sectors. All other sectors were evaluated using historical records and correlations with similar sectors. Evaluations were made for the minimum seven consecutive day, once-in-10-year unregulated stream flow.

Usually occurring coincident with this low flow was the maximum recorded temperature. A critical temperature of 77°F (25°C) was chosen for all the basin waters. There were only a few areas in which higher temperatures might have been used; none were lower.

Basic assumptions which entered into the calculations included:

1) The minimum or critical DO levels allowed in any stream were in accordance with the State's classification system in effect, with the exception of the Lower Genesee River. A recommended minimum of 4 mg/l of DO was used in this reach.
2) The DO of all waste effluents was at least 5 mg/l.

3) The 5-day BOD of the upstream or dilution water was no higher than 3 mg/l.

4) The DO in the upstream or dilution waters was at least at 90 per cent of saturation.

Table VII-1 is a summary of the assimilative capacity for 26 of the stream sectors found to be critically affected at the present time. On all of the reaches shown, the present capacity, during the 7 day once-in-10-year flow and the high temperature of 25°C, is less than the present loading to the stream.

Included in the 26 critical reaches are five on the Genesee River (below Kodak, Gates-Chili-Ogden, Avon, Curtice Burns at Mt. Morris, and Wellsville); three on Oatka Creek (LeRoy, Wyoming and Warsaw); two on Honeoye Creek (Rush and Honeoye Falls); and Wolf Creek (Castile and Silver Springs); and one each on Springbrook Creek (Caledonia); Black Creek (Churchville); Conesus Creek (Lakeville); Wilkins Creek (Livonia); Canaserga Creek (Dansville); Mill Creek (Wayland); Keshequa Creek (Nunda); Hemlock Outlet (Lima); Silver Lake Outlet (Perry); Angelica Creek (Angelica); Van Campen Creek (Friendship); Dyke Creek (Andover); and Cryder Creek (Whitesville).

The most seriously effected reaches are on the Genesee River below Eastman Kodak, Avon Village and Curtice Burns (at Mount Morris). The main source of waste at Avon is the industrial discharge by Birdseye Division of General Foods. Kodak's present loading, after primary treatment, is more than six times the stream capacity of 6,100 $lbs/_{BOD5}$. The discharge loading at Avon is six times the river's capacity. Stream degradation is common in this sector with many recorded fish kills because of DO depletions. At Mt. Morris, Curtice Burns discharges three times the river's capacity.

All those sectors for which the stream capacity is adequate after the present loadings are reduced by the addition of secondary treatment are in Table VII-1 with an asterick.

Table VII-1

PRESENT WASTE LOADS TO AND CAPACITIES OF

CRITICAL STREAM SECTORS

GENESEE RIVER BASIN

STREAM SECTOR	MIN. DO ALLOWABLE mg/l	CRITICAL TEMPERATURE (°C)	CRITICAL FLOW 7 DAY 1-10-YR. (cfs)	PRESENT STREAM CAPACITY (*) #BOD_5/DAY	PRESENT LOADING #BOD_5/DAY
Genesee River					
Kodak	4.0	25	370	6,100	55,300
Gates-Chili-Ogden	4.0	25	115	2,000	2,000 **
Avon	4.0	25	75	2,800	17,300 **
Curtice Burns at Mt. Morris	4.0	25	70	3,100	10,800 **
Wellsville	4.0	25	15	400	1,000 **
Honeoye Creek					
Honeoye Falls	4.0	25	0.3	25	250
Honeoye	4.0	25	0.1	10	100
Rush	4.0	25	1.5	80	330 **
Springbrook Creek					
Caledonia	5.0	25	7.0	270	280 **
Black Creek					
Churchville	4.0	25	0.9	30	200 **
Oatka Creek					
LeRoy	4.0	25	19.0	400	550 **
Warsaw	4.0	25	0.8	80	640
Wyoming	4.0	25	1.0	50	100 **
Conesus Creek					
Lakeville	4.0	25	0.6	30	200 **

Table VII-1 (cont'd)

STREAM SECTOR	MIN.DO ALLOWABLE mg/l	CRITICAL TEMPERATURE (^{o}C)	CRITICAL FLOW 7 DAY 1-10-YR. (cfs)	PRESENT STREAM CAPACITY (*) #BOD_5/DAY	PRESENT LOADING #BOD_5/DAY
Wilkins Creek					
Livonia	4.0	25	0.1	10	25
Canaeraga Creek					
Dansville	4.0	25	15	640	1,080 **
Mill Creek					
Wayland	4.0	25	0.2	20	300
Keshequa Creek					
Nunda	4.0	25	0.5	35	200 **
Wolf Creek					
Silver Springs	4.0	25	0.5	30	130 **
Castile	4.0	25	0.5	30	150 **
Silver Lake Outlet					
Perry	4.0	25	2.0 E	140	2,300
Angelica Creek					
Angelica	4.0	25	0.2	20	130 **
Van Campen Creek					
Friendship	4.0	25	0.5	40	250 **
Dyke Creek					
Andover	5.0	25	0.1	15	100 **
Cryder Creek					
Whitesville	5.0	25	1.0	35	

(*)Capacity of streams based on 85% treatment of all waste received, and under the conditions of low flow (7 day-1-10 year) and high temperature.

(**)Loading will be less than stream capacity with the construction of secondary treatment.

Table VII-2 is a presentation of those stream sectors that are projected as critically affected in 1980 and/or 2020, even with adequate treatment (85-90 percent in 1980 and 90 percent or better in 2020). The DO that can be expected in each reach because of the excess loading is shown. The reach below Kodak on the lower Genesee River will experience a DO of less than 1.0 mg/l under the projected loadings for both 1980 and 2020 during the time of low flow and high temperature. The reaches below Avon and Mt. Morris will experience only slightly less than the goal of 4.0 mg/l DO under projected loadings. All other reaches (Oatka Creek below LeRoy and Warsaw, Honeoye Creek below Honeoye Falls, Mill Creek below Wayland, Silver Lake Outlet below Perry, and Wilkins Creek below Livonia) are projected experiencing extremely low DO's in 1980 and 2020 under projected loadings.

D - Advanced Treatment Requirements

For the sectors shown in Table VII-2 there are two alternatives available for assuring that the minimum stream water quality goals would be met. Either additional treatment beyond the normal concept of secondary be considered, or the flows in the stream be augmented during periods of low flow to provide additional dilution water.

Table VII-3 is a presentation of the treatment needs, in terms of percent removal of BOD that must be effected in 1980 and 2020, if low flow augmentation is not feasible. Table VII-3 shows the year each sector must consider treatment above 90 percent.

E - Gross Dilution Requirements

The average monthly gross dilution or upstream flow requirements for adequate assimilation of projected waste loadings in each of the critical

Table VII-2

PROJECTED CAPACITIES, WASTE LOADS AND DO'S
CRITICAL[1] STREAM SECTORS - 1980 and 2020

Genesee River Basin

STREAM SECTOR	MIN. DO ALLOWABLE mg/l	YEAR 1980			YEAR 2020		
		#BOD_5/DAY		PROJECTED DO mg/l	#BOD_5/DAY		PROJECTED DO mg/l
		CAPACITY[3]	LOADING[2]		CAPACITY[3]	LOADING[2]	
Genesee River							
Kodak	4.0	6,100	16,600	0.6	6,400	18,000	0.9
Gates-Chili-Ogden	4.0	2,030	1,870	4.4	2,200	3,150	3.1
Avon	4.0	2,800	3,460	3.2	2,900	3,380	3.4
Oatka Creek							
LeRoy	4.0	--[4]	145	---	---[4]	155	---
Warsaw	4.0	90	220	0.0	100	200	0.9
Honeoye Creek							
Honeoye Falls	4.0	35	90[5]	0.0	55	100[5]	0.0
Mill Creek							
Wayland	4.0	25	60	0.0	30	50	1.9
Silver Lake Outlet							
Perry	4.0	175	580[6]	0.0	200	580[6]	0.0
Wilkins Creek							
Livonia	4.0	15	35	1.2	15	40	2.5

1 Critical sectors are defined as those sectors in which the water quality goals will be contravened even with secondary treatment

2 Treatment anticipated to be 85-90 percent in 1980; 90 percent or better in year 2020

3 All capacities and projected DO's were calculated for the minimum 7 consecutive day, 1-in-10-year low flow and the high temperature of 25°C

4 Capacity of stream in area downstream of LeRoy where flow reappears from underground passage is three times anticipated loading.

5 Loading calculated assuming reduced operations of Dutch Hollow Creamery

6 Based on assumption that Perry Knitting will experience normal gorwth

Table VII-3

ADVANCED WASTE TREATMENT NEEDS
(greater than 90 per cent BOD removal)
WITH PRESENT STREAM FLOW

STREAM SECTOR	YEAR ADVANCED TREATMENT BECOMES NECESSARY	TREATMENT NEEDS % REMOVAL OF BOD	
		1980	2020
Genesee River			
Kodak	1965	92	94
Gates-Chili-Ogden	1990	--	93
Avon	1990	--	91
Oatka Creek			
Warsaw	1965 (92%)	94	95
Honeoye Creek			
Honeoye Falls	1965 (96%)	98	98
Mill Creek			
Wayland	1965 (93%)	94	95
Silver Lake Outlet			
Perry	1965 (93%)	96	96
Wilkins Creek			
Livonia	1965 (94%)	95	96

stream sectors is shown in Table VII-4. These are the total stream flows that must be made available throughout the month specified in order to maintain the minimum DO desired in each stream sector. Eighty-five percent treatment was assumed, the minimum degree of treatment, until the year 1980; ninety percent or better was assumed necessary after that time.

As shown in Table VII-4, the gross dilution requirements for the Genesee River are very substantial, while the requirements for the tributary reaches are not significant in comparison to the needs on the river. The Genesee River at Gates-Chili-Ogden has adequate flows for secondary effluent until about 1990. By the year 2020, more than 160 cfs is needed during the month of July. The 1980 and 2020 stream flow requirements below Avon in July are both nearly 90 cfs.

The reach below Kodak in the Lower Genesee has the greatest gross dilution requirement. Figures VII-1 and VII-2 are presented to give a clearer picture of the alternatives needing evaluation in this section of the river. As shown in Figure VII-2, between 93 and 95 percent treatment will be necessary by the year 1980 to maintain 4.0 mg/l. in the river for a flow of approximately 400 cfs; approximately 90 percent treatment is needed at present.

Table VII-4

Gross Stream Flow Requirements

for Critical Stream Sectors
Genesee River Basin

(Cubic Feet Per Second)

Stream Sector	Year	D.O. Goal mg/l	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Average Monthly Flow
Genesee River	1965	4	130	130	160	180	340	530	660	630	630	440	260	160	360
Kodak	1980	4	200	200	230	270	510	800	980	940	940	660	390	240	530
	2020	4	180	180	210	250	490	780	970	930	930	640	380	220	510
Genesee River	1965	4	3	3	4	4	13	20	25	24	24	17	8	4	12
Gates-Chili-	1980	4	18	18	22	26	57	85	106	101	101	70	40	23	55
Ogden	2020	4	26	26	30	38	82	134	166	158	158	110	62	34	85
Genesee River	1965	4	20	20	25	29	53	69	81	81	81	57	37	23	48
Avon	1980	4	20	20	25	29	57	77	93	89	89	61	41	29	52
	2020	4	20	20	25	29	53	73	89	89	89	61	41	26	51
Oatka Creek	1965	4	.1	.1	.2	.4	1.9	2.5	3.3	1.9	1.7	.9	.4	.1	1.1
Warsaw	1980	4	.1	.1	.3	.5	2.2	2.9	3.9	2.2	2.0	1.0	.5	.1	1.3
	2020	4					1.1	2.0	2.8	1.3	.11	.3			.7
Honeoye Creek	1965	4	.8	.8	1.0	1.1	2.6	3.6	4.2	4.1	4.1	2.6	1.7	1.0	2.3
Honeoye Falls	1980	4	1.3	1.3	1.6	1.8	4.3	5.9	6.9	6.6	6.6	4.3	2.9	1.6	3.7
	2020	4	.9	.9	1.2	1.4	4.0	5.5	6.4	6.4	6.4	4.1	2.4	1.2	3.4

Note: Treatment was considered 85-90% until 1980; 90% or better thereafter.

Table VII-4 (cont'd.)

Gross Stream Flow Requirements

for Critical Stream Sectors
Genesee River Basin

(Cubic Feet Per Second)

Stream Sector	Year	D.O. Goal mg/l	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Average Monthly Flow
Mill Creek	1965	4					.4	.5	.6	.4	.3	.1			.2
Wayland	1980	4					.5	.6	.7	.5	.4	.2			.2
	2020	4					.2	.2	.3	.1	.1				.1
Silver Lake	1965	4	1.1	1.1	1.5	1.6	4.5	5.2	6.1	4.2	3.7	2.4	1.6	1.1	3.0
Outlet	1980	4	1.8	1.8	2.4	2.7	7.6	8.6	10.0	7.0	6.1	4.0	2.7	1.8	4.7
Perry	2020	4	1.1	1.2	1.8	1.9	6.2	7.2	8.1	5.9	5.1	3.1	1.9	1.2	3.7
Wilkins Creek	1965	4			.1	.1	.3	.4	.6	.6	.6	.3	.2	.1	.2
Livonia	1980	4			.1	.1	.4	.6	.9	.9	.7	.4	.2	.1	.4
	2020	4					.3	.5	.9	.7	.6	.3	.1		.3

Note: Treatment was considered 85-90% until 1980; 90% or better thereafter.

FIGURE VII-1

DISSOLVED OXYGEN - STREAM FLOW RELATIONSHIPS

JULY, 1965

LOWER GENESEE RIVER BELOW KODAK

ASSUMED UPSTREAM CONDITIONS

DO at 90% Saturation

BOD_5 at 3.0 ppm

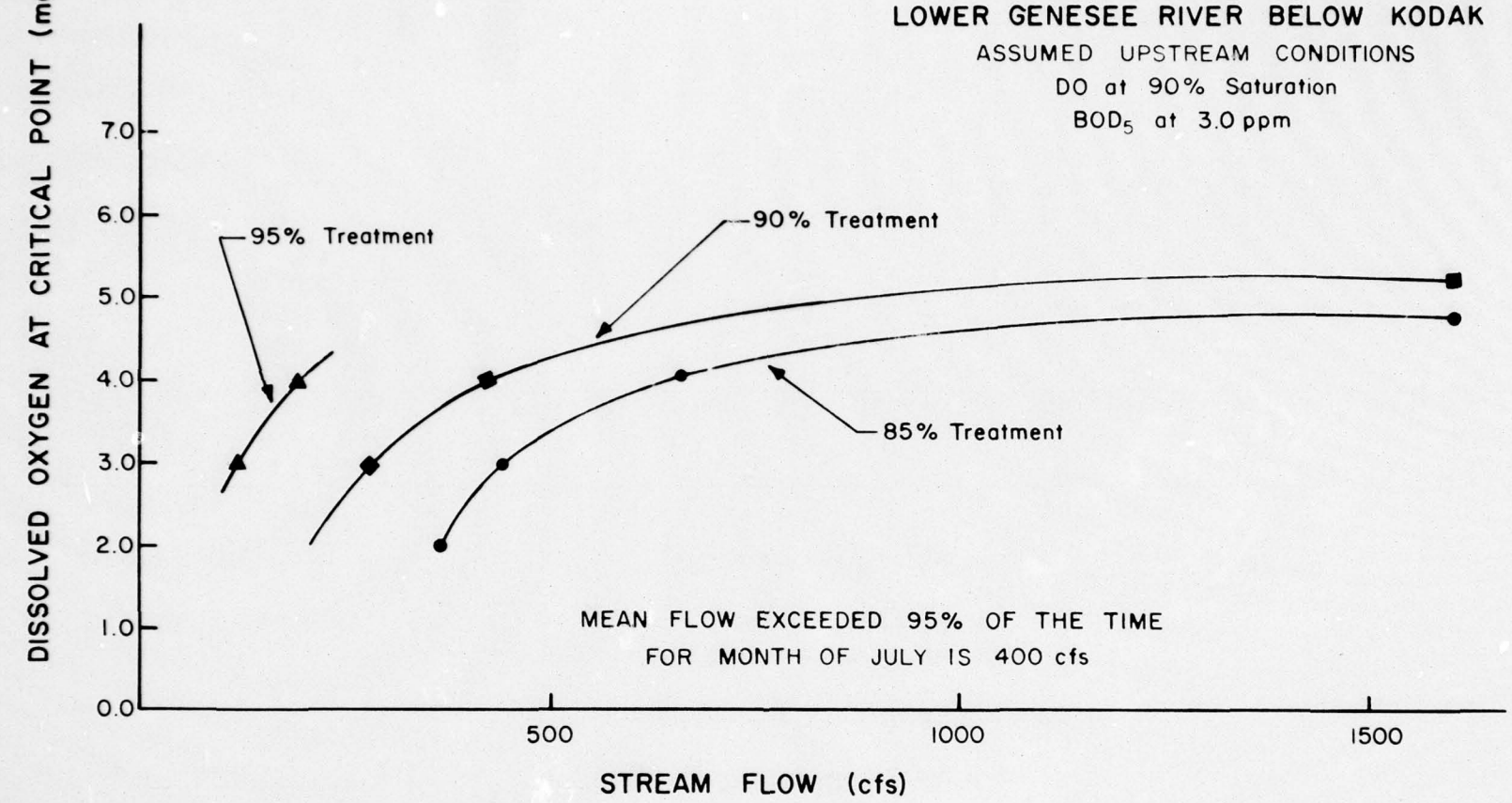


FIGURE VII-2

DISSOLVED OXYGEN - STREAM FLOW RELATIONSHIPS

JULY, 1980 ●——●

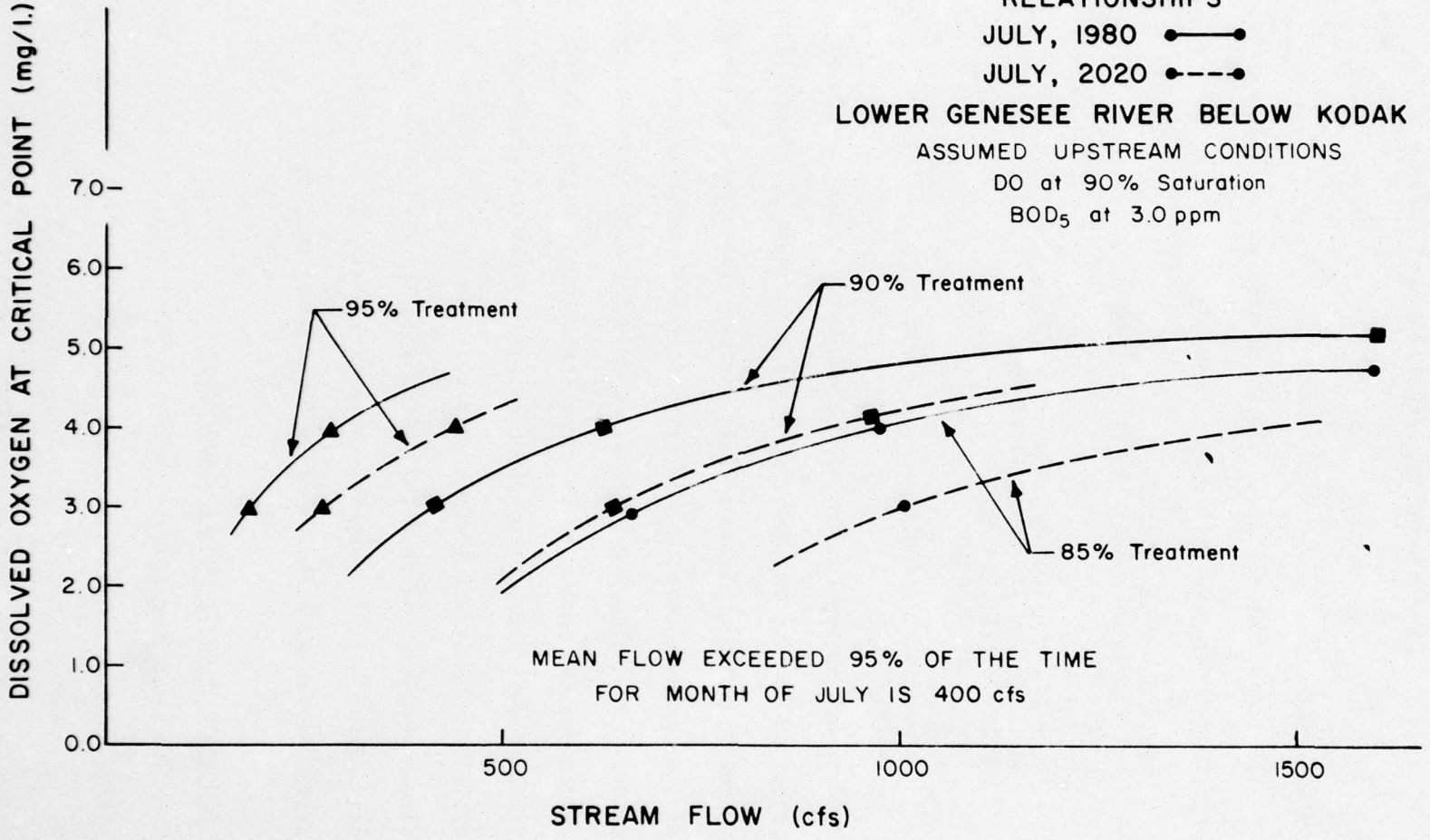
JULY, 2020 ●- - -●

LOWER GENESEE RIVER BELOW KODAK

ASSUMED UPSTREAM CONDITIONS

DO at 90% Saturation

BOD_5 at 3.0 ppm



Chapter VIII

Future Water Quality Management Needs

A - Water Uses

The uses that are presently being made of the basin waters can be described within the following categories:

Municipal Water Supply
Self-Supplied Industrial Process Water
Recreation
Irrigation
Fish and Aquatic Life
Wildlife and Livestock Watering
Hydroelectric Power
Commercial Shipping
Cooling
Waste Assimilation
Esthetics

An exhaustive summary of the present uses was presented in two recent reports by the New York State Department of Health, entitled, "Upper" and "Lower Genesee River Basin." These reports formed the basis of the present State classifications of best usage assigned to the basin waters. Utilizing the information on water uses in these reports as a framework, and adding to it where there appeared to be deficiencies, a table of uses made of the major stream sectors was prepared (See Table VIII-1). The stream sectors were selected on the basis of variations in stream quality, the physical features of the stream, and changes in water use. Table VIII-1 indicates those uses which are anticipated for each stream sector as a result of improved water quality.

B - Significant Water Quality Parameters

The next step in development of water quality goals is to define criteria which limit those parameters which affect adversely the desired

Table VIII-1

PRESENT AND ANTICIPATED WATER USES

GENESEE RIVER BASIN

WATER USES	GENESEE R.						BLACK CREEK	OATKA CREEK			HONEOYE CREEK	CANASERAGA CREEK	KESHEQUA CREEK	WISCOY CREEK	LAKES				
	1	2	3	4	5	6	1	1	2	3	1	1	1	1	1	2	3	4	5
Municipal Water Supply				A	P	P									P	P	P	P	P
Self-supplied Industrial Water	A	P	P	A	P	P	P	P	P	P	P	P	P	P			P	P	P
Recreation: Whole Body Contact			A		A			P									P	P	P
Recreation: Partial Body Contact	P*	P*	P*	P*	P	P	P*	P	P	P	P	P	P	P	A	A	P	P	P
Irrigation			P		A	A	P	A	A										
Fish and Aquatic Life: Group 1																			
Group 2	P*	P*	P*	P*	P		P*		P		P	P	P	P	P	P	P	P	P
Group 3						P		P		P		P		P	P	P			
Wildlife and Stock Watering			P	P	P	P	P	P	P	P	P	P	P	P					
Hydroelectric Power		P		P	A									P					
Commercial Shipping	P	P																	
Cooling Water		P	A				A		P			P							
Waste Assimilation	P	P	P	P	P	P	P	P	P		P	P	P	P			A		
Esthetics	P*	P*	P*	P*	P	P	P*	P*	P	P	P	P	P	P	P	P	P	P	P

NOTE: The Number 1, alone, indicates that the entire body of water has been considered as one sector.
A = Anticipated future use.
P = Present use and anticipated future use.
P* = Use presently impaired by water quality.

Stream	Sector	Description
Genesee River	1	Lake Ontario to Driving Park
	2	Driving Park to Barge Canal
	3	Barge Canal to Mt. Morris
	4	Mt. Morris to Portageville
	5	Portageville to Wellsville
	6	Above Wellsville
Oatka Creek	1	Genesee River to LeRoy
	2	LeRoy to Warsaw
Oatka Creek	3	Above Warsaw
Lakes	1	Hemlock
	2	Canadice
	3	Conesus
	4	Silver
	5	Honeoye

uses of the waters. Limits were not set for all water quality parameters but rather for those parameters which are generally most significant in the Genesee River basin. The following parameters, and their significance are included:

Dissolved Oxygen (DO)

Dissolved Oxygen is one of the most important indicators of water quality. Adequate DO levels are necessary to support desirable fish and aquatic life. Significant introductions of organic material, coupled with low DO levels, can severely degrade a stream; and under certain conditions, the stream will take on the character of an open sewer. The DO test also serves as the basis of the Biological Oxygen Demand (BOD) test.

DO can be easily measured instrumentally or by simple laboratory and field procedures without prior treatment of the sample. With continuous monitoring of DO at selected locations, water stored for water quality control may be released in a manner that will maintain prescribed DO levels.

Biochemical Oxygen Demand

BOD is a measure of the oxygen consumed by bacteria during the process of reducing organic material to simpler forms. The BOD test is performed by measuring the change in dissolved oxygen in a sample after a specific period of incubation under standard conditions. This incubation period is commonly five days. When used alone, the BOD test serves as one measure (in terms of oxygen-consuming ability) of the organic pollution present in a stream. BOD measurements taken together with DO values are used to evaluate the self-purification capacity of a stream.

Hydrogen-Ion Concentration (pH)

pH is the logarithm of the reciprocal of the hydrogen-ion activity and indicates whether waters are acidic, neutral, or basic. A pH of 7.0 is the neutral point. pH values less than 7.0 indicate an acid condition. Low pH or acidic conditions tend to accelerate pipe corrosion, decompose concrete, and intensify the toxic action of sulfides and cyanides. High pH values disrupt biolological activity and precipitate iron as an hydroxide. For biological degradation of organic wastes, a pH in the 5 - 9 range is most desirable.

pH is a parameter which can easily and readily be determined instrumentally without treatment of the sample in any way. The output from a glass electrode can be coupled to a continuous recorder for automatic monitoring of pH in streams.

Coliform Bacteria

The coliform group of microorganisms as specified here is defined in Standard Methods: "The coliform group includes all of the aerobic and facultative anaerobic, gram-negative, nonsporeforming, rod-shaped bacteria which ferment lactose with gas formation within 48 hours at 35°C." By definition the coliform group embraces several varieties of bacteria which differ in biochemical characteristics, as well as in natural sources and habitats. Coliform bacteria are found in the fecal matter of all warm blooded animals, including man. Some varieties abound in nature, such as in soils and on plants. Enteric pathogens, disease-producing organisms of intestinal origin, may also be present in fecal matter. Pathogenic bacteria are likely to be present. However, other supplementary tests increase the certainty of indicating recent fecal contamination. Among

these supplementary tests are those for enterococci and fecal streptococci. In addition, confirmation tests at an elevated temperature more precisely indicate coliform bacteria of fecal origin.

Turbidity

Turbidity is significant in industrial process water and public water supplies. Certain industrial uses are impaired by high turbidity and the consuming public tends to associate turbid water with possible pollution. The degree of turbidity substantially affects the amount of treatment that water would require before consumption. High turbidities restrict passage of light to photosynthetic biota and thus are deleterious to stream environment.

Temperature

Temperature has a marked effect on the sanitary and ecological characteristics of a stream. Oxygen solubility is inversely proportional to temperature. Temperature increase also accelerates the rate of oxygen utilization by biological life. Abnormally high temperatures are detrimental to fish and aquatic life. The efficiency of cooling processes decreases as temperature increases. Widespread availability of thermistor devices has made practicable the operation of monitoring stations for temperature measurement and recording.

Dissolved Solids

Dissolved Solids is the popular term for the total amount of dissolved material, organic and inorganic, contained in water or wastes. In the latest edition of Standard Methods the standard test is identified by the more precise title: "Dissolved Matter (Filtrable Residue)." Certain

industrial applications have limits on the amounts of total dissolved solids (TDS) that can be present in their supplies. Excessive dissolved solids in water can make the water unpalatable and in certain cases cathartic. Increased treatment costs are also a consequence of excessive dissolved solids. Potable water supplies often have total solids contents ranging from 20 to 1,000 mg/l. The USPHS Drinking Water Standards recommend the rejection of sources having more than 500 mg/l of TDS, if a better source can be reasonably developed.

Color

Color in water indicates the presence of suspended or dissolved material, or both. Color is often leached from organic debris and consists chiefly of vegetable extracts such as tannin and humic acid. Textile and paper industries can contribute substantial amounts of highly colored liquors which may be resistant to biological attack. The presence of color is considered undesirable in municipal and certain industrial water supplies and it can be indicative of the presence of harmful wastes.

Phenolics

Phenols are significant chiefly in the water supply field. The presence of as little as 1 microgram per liter, one part per billion, of chlorinated phenols can impart a taste to drinking water. Phenol introduction into a body of water can lead to the tainting of fish flesh. The procedure for phenol detection also detects ortho and meta-substituted phenols and para-substituted phenols when the substituent is a carboxyl, halogen, methyl, hydroxy, or sulphonic acid group. Detection of these aromatic compounds in significant concentrations usually indicates industrial pollution.

Chlorides (Cl)

Natural waters often contain chlorides but sewage or waste waters usually contain much higher concentrations than those occurring naturally in this part of the country. As chloride concentration increases, palatability is affected, corrosiveness increases, and irrigation usage is impaired. The USPHS Standards for Drinking Water recommend that a limit of 250 mg/l be established for supplies intended for public use.

Ammonia (NH_3) and Organic Nitrogen

Ammonia and organic nitrogen serve as indicators of the freshness of sewage. Waters in which most of the nitrogen is in the form of organic and ammonia nitrogen are considered to have been recently polluted. The presence of ammonia in municipal water sources is particularly significant due to its marked effects on the amount of chlorine needed to obtain free chlorine residuals in break-point chlorination. Ammonia is also capable of exerting a significant oxygen demand in surface waters. Toxicity of ammonia to aquatic life increases with increasing pH.

Nitrates (NO_3)

Nitrate nigrogen is generally present in relatively small quantities in unpolluted surface waters. Any significant increase in its concentration serves to indicate that the water characteristics have been altered by wastes from industrial, domestic and agricultural activities. Nitrate nitrogen is the most highly oxidized form of ammonia and consequently is the most stable state in the nitrogen cycle. Organic nitrogen is converted to ammonia nitrogen which is then oxidized to nitrite and subsequently to nitrate. When a stream is depleted of DO, the stream will utilize the oxygen of the nitrate as an alternate source of oxygen. High

concentrations of nitrate nitrogen are reported to cause methemoglobinemia in infants. A limit of 45 mg/l of nitrate is recommended in the USPHS Drinking Water Standards.

Of particular significance in natural waters is the necessity of nitrates to the completion of the normal cycle of aquatic life. If present with phosphorus in optimal amounts, massive growths of algae and plankton can result. Certain types of these growths can be troublesome to municipal water plant operation. They can also cause taste and odor problems. Others can cause unsightly conditions in streams and along shorelines.

Phosphates (PO_4)

Biological activity requires the presence of phosphate. The two predominant sources of phosphate are animal and human waste matter, and synthetic detergents, with the latter often contributing as much as 2-3 times more than the former. Runoff from fertilized fields and industrial wastes will also contain phosphate. The bacteriological mechanism of stream purification requires phosphate to permit the purification process to proceed at an optimum rate; phosphate is not considered harmful to human health. Phosphate in optimal quantities, when coupled with sufficient nitrogen, sunlight and food, can promote massive growths of algae and plankton which affect water uses as discussed under nitrates.

C - Water Quality Goals

The development of water quality goals is essentially a two-step process: (1) Defining and arraying the technical needs or criteria to accommodate each individual water use; and (2) judging the compatibility of competing water uses according to the controlling criteria.

The criteria recommended for the various water uses in the Genesee Basin are arrayed in Table VIII-2. These criteria are based on latest knowledge and practices. Essentially these criteria are the maximum or minimum desirable concentrations of various water quality parameters, above or below which, the stated water uses would be adversely affected. Limits were not set for all parameters, but rather for those which are generally most significant in the Genesee River basin. As shown, minimum dissolved oxygen requirements, and maximum phenol, chloride, soluble phosphate, ammonia nitrogen, turbidity, temperature, color, BOD, and dissolved solids concentrations were established.

Table VIII-3 is a list of fish species grouped according to similarity of water quality requirements. These groups are indicated on Table VIII-2 as numbers 1, 2, and 3, which correspond to Tolerant, Facultative, and Intolerant species, respectively.

The coliform parameter is probably the most troublesome as far as the setting of criteria and establishment of quality goals are concerned. Criteria values set by collective agreement may not take into account situations wherein background coliform values are consistently higher than the criteria, even in the apparent absence of fecal contamination. Further, a low coliform count is not absolute assurance that recreational water for whole body contact is bacterially safe. In previous paragraphs it was pointed out that additional tests are available that better serve to identify the presence or absence of recent fecal contamination. Five separate criteria have been defined which relate to specific water uses. These criteria use fecal streptococci counts to more clearly indicate the safety of the water for the particular use. As new tests for fecal coliform bacteria are applied, it is anticipated that still more meaningful

Table VIII-2

GENESEE RIVER BASIN

PROPOSED CRITERIA FOR WATER QUALITY

	WATER QUALITY PARAMETER											
	DO (min) mg/l % Saturation	pH (Range)	Phenolics (max) mg/l	Chlorides (max) mg/l	Phos. Soluble (PO_4) (max)	NH_3 - N (max) mg/l	Turbidity N.4/5 (max)	Temperature F° (max)	Color Units (max)	Coliform Guide	BOD_5 (max) mg/l	Dissolved Solids (max) mg/l
Municipal Water Source	80	7.7 -9.0	.003	250	.03	0.1	NLS	NLS	15	C	8	500
Industrial Process Water	1.0 (1)	5-9	1.0	250	.03	5	250	90	100	D	10	750
Recreational-Whole Body Contact	3	NLS	1.0	- (4)	.03			90	50	A	NLS	-
Recreational-Limited Body Contact	3	5-9	1.0	-	.03		250	90	50	B	NLS	-
Irrigation	1	5-9		NLS	.03		-	NLS	-	D	NLS	1400
Fish and Aquatic Life Group 1	3	6-9	0.2 (2)	500	.03		250	82	50	B	-	-
Fish and Aquatic Life Group 2	4	6-9	0.2 (2)	500	.03		250	82	50	B	-	-
Fish and Aquatic Life Group 3	5	6-9	0.2 (2)	500	.03		250	58	50	B	-	-
Wildlife and Livestock Watering	1	5-9	NLS	2000	.03		250	100	-	NLS	-	2500
Hydroelectric Power	-	5-9	-	-	-	-	250	-	-	-	-	-
Commercial Shipping	-	5-9	-	-	-	-	250	-	-	B	-	-
Cooling	-	5-9	-	700	-	-	250	90	-	-	-	-
Esthetics (3)	1	-	-	-	.03		NLS	-	-	-	-	-
Waste Water Assimilation	1	5-9	NLS	-	.03		-	110	-	-	NLS	-

(1) NLS denotes no limits set.
(2) With respect to toxicity. NLS with regard to tainting of fish flesh.
(3) To be esthetically pleasing, the water should be free of floating debris, solids, scum, oil, and grease derived from the activities of man.
(4) A dash indicates that the parameter is not expected to be detrimental to the water use at the values normally encountered in the Genesee River Basin.

Table VIII-3

FISH SPECIES

WITH SIMILAR WATER QUALITY REQUIREMENTS

Tolerant Fish (Group 1)

Carp
Goldfish
Suckers
Gar
Catfish

Facultative Fish (Group 2)

Walleyed Pike
Northern Pike
Largemouth Bass
Bluegill Sunfish
Perch
Crappies
Shiners
Bluegill Fingerlings
Smallmouth Black Bass

Intolerant Fish (Group 3)

Rainbow Trout
Brook Trout
Brown Trout
Lake Trout
Stickleback

criteria will be developed. Coliform criteria A, B, C, and D (as shown in Table VIII-2) apply specifically to recreational, municipal, industrial, and irrigation water uses.

Coliform Criteria A - Recreational, whole body contact use. The water uses for which this criteria is intended are those that entail total and intimate contact of the whole body with the water. Examples of such use are swimming, skin diving, and water skiing, in which the body is totally immersed and some ingestion of the water is expected. The recommended criteria value for coliforms is 1,000/100 ml (1,000 per 100 milliliters). For all waters in which coliform levels are below the criteria value of 1,000/100 ml, the water is considered suitable provided there is proper isolation from direct fecal contamination as determined by a sanitary survey. Situations may arise wherein waters having coliform counts somewhat higher than the criteria value can be used, provided supplemental techniques are used to determine safe bacterial quality. The analysis for fecal streptococci is more definitive for determining the presence of organisms of intestinal origin and is suggested as the supplemental technique to be employed. Based on a very limited amount of information, a limit of about 20/100 ml is suggested for fecal streptococci, providing there is an accompanying limit on the coliform level. Provisionally, it is suggested that a coliform level of 10,000/100 ml be permitted provided the fecal streptococcus count is not more than 20/100 ml and that there is proper isolation from direct fecal contamination as determined by a sanitary survey.

Coliform Criteria B - Recreational, limited body contact use and commercial shipping (barge traffic). The water uses for which this criteria is intended are those that entail limited contact between the water

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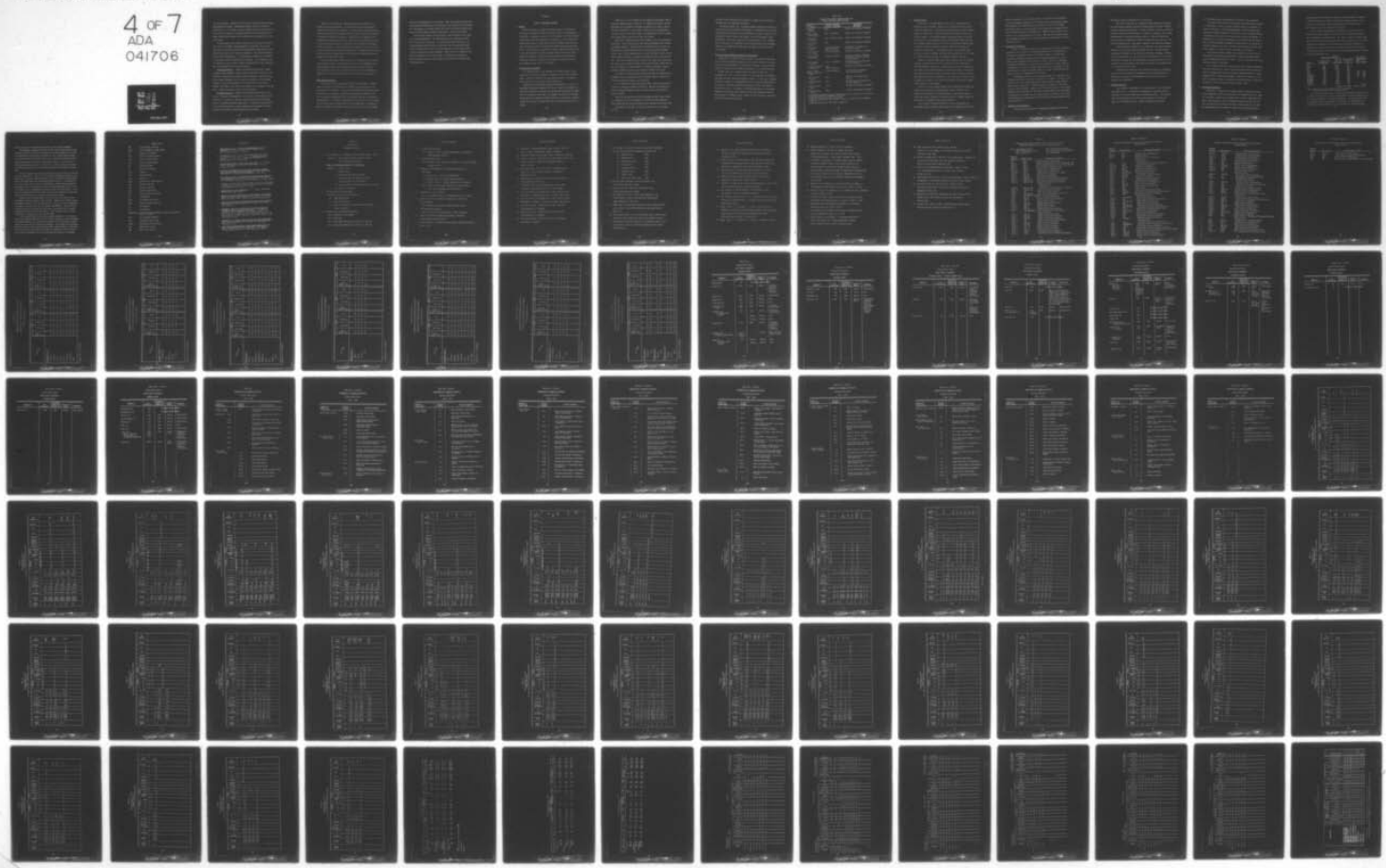

user and the water. Examples of such uses are fishing, pleasure boating, and commerical shipping. Recommended criteria value for coliforms is 5,000/100 ml. For all waters in which coliform levels are below this criteria value, the water is considered suitable for use provided there is proper isolation from direct fecal contamination as determined by a sanitary survey.

For waters which have coliform levels above the criteria value and such levels are evidently caused primarily by organisms of other than fecal origin, the limiting count may be 50,000/100 ml provided the fecal streptococcus count is not more than 100/100 ml. With the accompanying limit on fecal streptococci, it is reasonable to expect that the danger of infection by enteric organisms will be remote. It is understood that the provisional limit would be subject to modification as more analytical data are accumulated and critically reviewed.

Coliform Criteria C - Applies to Municipal Water Source. Where municipal water treatment includes complete rapid-sand filtration or its equivalent, together with continuous postchlorination, source water may be considered acceptable if the coliform concentration (at the intake) averages not more than 5,000/100 ml in any one month and the count exceeds this number in not more than 20 percent of the samples in any one month. Samples should be tested at least once daily.

Coliform Criteria D - Applies to Industrial Process Water at the source. Although the requirements of this use will vary widely with the processes of a particular industry, coliform criteria C for municipal source is considered generally applicable. As covered by food and drug acts and other regulations, water incorporated into products for human ingestion should meet finished drinking water standards.

There are many sections in which specific uses discussed in this chapter are being jeopardized. The affected sectors are indicated on Table VIII-1 by means of an asterisk. In those sectors where pollution is adversely affecting water quality, pollution control measures are required to restore and preserve the quality. Table VIII-4 is a summary of the proposed water quality goals for the entire basin, including those sectors for which the present quality is well within the criteria of the present and anticipated uses. The existence of such situations is not to be construed as relieving the producer of wastes from his responsibility of treating them before discharge; rather, this fortunate situation should be regarded as providing room to grow.

The goals presented in Table VIII-4 can be considered as the controlling parameter levels. All possible uses that can be accommodated within these parameter levels are also arrayed side by side with the goals. These include uses with less restrictive criteria than those considered as competing uses (those listed as present and anticipated in Table VII-1).

Water Quality Standards

The main stem of the Genesee River basin from its origin in Pennsylvania to its mouth at Lake Ontario is subject to the provisions of the Water Quality Act of 1965. As such, it is considered an interstate stream and the State is obligated to establish water quality standards for the river in general accordance with the "Guidelines" outlined in May 1966 by the Secretary of the Interior. New York has indicated that it will, before June 30, 1967, adopt (a) water quality criteria applicable to interstate waters or portions thereof within the state, and (b) a plan for the imple-

mentation and enforcement of the criteria. When such criteria and plan are established and determined by the Secretary of the Interior to be consistent with the purposes of the Water Quality Act, then the criteria and plan will become the water quality standards applicable to the waters involved.

There are many sectors in which specific uses discussed in this chapter are being jeopardized. The affected sectors are indicated on Table VIII-1 by means of an asterisk. In these sectors where pollution is adversely affecting water quality to the extent that the established water quality criteria are not met, the criteria become the water quality goals to be met by pollution control measures. Table VIII-4 is a summary of the water quality goals for the entire basin, including those sectors for which the present quality is well within the criteria of the present and anticipated uses.

Chapter IX

QUALITY IMPROVEMENT MEASURES

A - General

Measures required to improve the water quality of the Genesee River basin are generally within the present limits of technology and feasibility. Paramount is the need for construction of new and improved facilities, by both municipalities and industries. The continuous and adequate monitoring of stream water quality, treatment plant efficiencies, and sophistication of operating procedures are equally pressing needs. Flow regulation is required to provide additional dilution water in the lower Genesee and certain upstream sectors if alternate high degrees of treatment or exclusion of wastes proves less economical. Other needs include a solution to the problem of overflows from combined sewers and the control of nutrients.

B - Municipal Waste Treatment

The immediate goal in the treatment of municipal wastes is the provision of secondary (biological) treatment at each waste treatment plant. Additional treatment by other control measures are needed at several locations to meet water quality objectives.

Reduction of the effluent phosphate concentration is a vital requirement of municipal treatment facilities. Research in progress has shown that substantial reductions can be obtained by changing the operation of conventional facilities. For example, increasing the aeration and decreasing the degree of primary settling in conventional activated sludge units greatly increases the amount of nutrient removal by this process.

Table IX-1 is a basin summary of the immediate improvement needs in municipal sewage treatment facilities. A community of greater than 500 population was considered the minimum concentration for which a public collection system must be installed. There are 44 such communities in the basin; only 17 have public sewers. The population of the 27 communities without public sewers totals more than 25,000.

Among the 17 communities with public sewers, only 13 have treatment facilities. One of these plants, the secondary treatment plant at Geneseo, appears adequate. The two remaining secondary plants, Livonia and Honeoye Falls, need immediate provision for advanced waste treatment units. Both of these communities must achieve treatment in excess of 90 percent removal of BOD, if upstream flow regulation proves less economical. The existing primary plants at Wellsville, LeRoy, Avon, Dansville, Mt. Morris, York, Gates-Chili-Ogden, Scottsville, Brighton Sewer District No. 5, and Warsaw all need expansion to secondary treatment. Bergen, Caledonia, Mumford and Perry need secondary treatment facilities.

The plants at Perry and Warsaw must be provided with adequate waste treatment units to achieve more than 90 percent removal of BOD if upstream flow regulation proves less economical.

All 27 communities presently without public sewers need collection systems and secondary treatment facilities. Wayland and Honeoye must plan for advanced treatment units that achieve more than 90 percent removal of BOD.

There are two locations, Gates-Chili-Ogden and Avon, where secondary treatment will only be adequate for the present waste loadings. Both communities must provide advanced waste treatment by the year 1990.

Disinfection facilities and operation thereof must be provided for all.

Municipal waste treatment plant effluents to comply with the policy of the New York State Department of Health.

The present capital cost to provide secondary treatment facilities in the basin has been estimated at $11,500,000. The additional cost of providing advanced treatment for those communities listed in Table IX-1, requiring more than 90 percent BOD removal, has been estimated at about $1,000,000. These costs represent the initial project costs. However, up to 85 percent of the eligible cost of treatment works and interceptor sewers may be reimbursable under State and federal construction grant aid programs.

C - Industrial Waste Treatment (Separately Discharging)

Reexamination of Chapter IX will show that at the present time very few industries discharging separately to the surface waters of the basin provide any waste treatment. As indicated in Chapter VI, many of these industrial discharges are extremely detrimental to the receiving waters.

Minimum industrial treatment needs are listed in Table IX-2. In developing this list, it was considered that the equivalent of secondary treatment would be required throughout the basin. In some cases necessary additional treatment is recommended where an anticipated loading exceeds the stream's assimilative capacity and adversely affects the desired water quality goals. In addition to necessary reductions in the organic industrial waste loads, other control measures are stipulated, such as the reduction of suspended solids, removal of toxic materials, and disinfection of plant sanitary wastes.

Table IX-2

PRESENT PLANT WASTE REDUCTION NEEDS FOR
MAJOR INDUSTRIAL WASTE SOURCES

INDUSTRY LOCATION	PRESENT TREATMENT OR CONTROL MEASURES	RECOMMENDED MEASURES
Ainsbrook Warsaw	None	Primary and Secondary Treatment
Bordens Foods Whitesville	Part - Subsurface	Primary and Secondary Treatment
Conesus Milk Lakeville	Part - Settling Tanks	Primary and Secondary Treatment
Conesus Milk Nunda	None	Primary and Secondary Treatment
Curtice Burns Bergen	Vibrating Screens - Spray Irrigation	Enlargement of lagoons and control of runoff
Curtice Burns[1] Mt. Morris	Vibrating Screens	Primary and Secondary Treatment
Eastman Kodak[2] Rochester	Primary Treatment	Secondary Treatment (90% BOD reduction); effluent pipeline to Lake Ontario
Foster Wheeler Dansville	Part - Subsurface	Neutralization, precipitation of toxic materials
Friendship Dairies Friendship	Part - Spray Irrigation	Primary and Secondary Treatment
General Foods - Birdseye Division[3] Avon	Vibrating Screens	Joint Secondary Treatment with Village of Avon
Lapp Insulator LeRoy	None	Settling of Suspended Clay Solids
Lucidol Chemical Avon	None	Neutralization, precipitation of toxic materials
Perry Knitting[4] Perry	None	Primary and Secondary Treatment
Sunnydale Farms Andover	None	Primary and Secondary Treatment

1 Completed planning of treatment facilities
2 Presently planning secondary facilities.
3 Completed negotiations with Village of Avon to construct joint secondary facility.
4 Presently operating at one-tenth of capacity

D - Combined Sewers

Historically, the development of our nation's sewerage system followed a general pattern. Diversion of storm water was the earliest concern of communities. Discharges were made directly to water courses, usually at many points. Later these sewer systems were used to carry sanitary sewage. As the public became increasingly aware of the need for treatment of sanitary waste waters, the many short sewers discharging untreated domestic wastes to a stretch of stream were provided with interceptors and the collection system was modified to deliver the wastes to a single point - the treatment plant. When sanitary wastes and storm water are combined, the sewers overflow directly to the stream at times of high flow because of inadequate hydraulic capacity.

Studies of combined sewer systems have indicated that the combined overflow contained from three to five percent of the average annual untreated domestic sewage flow. During storms as much as 95 percent of the sewage flow is discharged with the storm water runoff. Storm water alone was demonstrated to carry significant amounts of pollution load, particularly during the early period of the storm when a flushing action occurred in the sewers. The storm water flushed large amounts of deposited sludge out of the sewers.

Solutions to the overflow problems from combined sewer systems are needed, and the subject is receiving much current attention. The Federal Water Quality Act of 1965 established a four-year program of grants and contract authority to demonstrate new or improved methods of eliminating the combined sewer overflow problems.

Until feasible economical methods of solving the problems are developed, existing combined sewer systems must be properly maintained.

Adequate provisions for continuous cleaning and repairing of interceptors and relief chambers, especially in the large Rochester metropolitan system, and adjustment of overflow regulating structures to convey the maximum practicable amount of combined flows to and through waste treatement facilities are basic municipal responsibilities. Combined sewers should be prohibited in all newly developed urban areas. Many existing combined systems may be separated according to a long range program in conjunction with urban renewal projects.

E - Reduction of Nutrients

There is an immediate need for the reduction of nutrients, especially phosphates, to the waters of the Genesee River basin. The Genesee River discharges an enormous quantity of nutrients annually to Lake Ontario. proximately 325,000 pounds per year of soluble phosphates, such as phosphorus, were discharged to Lake Ontario in 1965. The level of nutrients considered by Sawyer(8) as critical for the stimulation of algal blooms in lake waters is 0.01 mg/l of soluble phosphates, such as phosphorus, in conjunction with an inorganic nitrogen level of 0.30 mg/l occurring under the proper conditions of temperature and sunlight.

The phosphate removal by the existing municipal and industrial waste treatment facilities in the basin is minimal. The larger facilities in the basin are all of the primary type, which rarely achieve nitrogen removals greater than 25 percent(9). Phosphate removals are known to vary among plants of similar design. However, up to 75 percent removal of the soluble phosphate can be achieved with activated sludge treatment plants by properly adjusting such variables as the amount and time of aeration and the bacterial population, compared with very little if any phosphate removal with primary plants(10).

F - Efficient Plant Operation

The design and construction of adequate treatment plants must be

followed by efficient operation of the facilities.

The State of New York has a mandatory sewage treatment plant operator certification program, and State sponsored operator training programs are being conducted continuously. A useful extension of this program might include a training team consisting of a chemist, an engineer, and an experienced operator to provide on-the-job training. There are indications that this would accelerate the training of operators now on the job. This could be developed into a semi-annual inspection and instruction program.

Monthly operation reports must be submitted to the State Health Department on each municipal waste treatment facility. Recently enacted legislation "providing for the testing and measuring of sewage, industrial waste or other wastes, at their outlet into classified water of the state, and further providing for the maintaining of a permanent record of the resulting data, and periodically reporting such record to the commissioner" (11) should fulfill this need.

Municipalities operating waste treatment facilities in accordance with the rules and regulations promulgated by the State Commissioner of Health may be eligible for reimbursement of one third of the cost of operation and maintenance.

G - Effluent Pipelines

With regard to improvement of the water quality of the lower Genesee River, there is an additional consideration of transporting waste effluents to locations affording more favorable dilution. The effluents from the Eastman Kodak plant and the municipalities of Livonia and LeRoy are of immediate concern. Based on preliminary estimates,

such a measure appears more economical than other control measures.

The logical new location for discharging the Eastman Kodak effluent is Lake Ontario. There are several possible routes of conveyance and points of discharge. The optimum combination of design feature must provide the maximum dispersion in the lake to assure a minimum effect on the quality of the water with the least cost of piping and pumping. A prerequisite in any plan to discharge to the lake would be the requirement of minimum secondary treatment and disinfection of the effluent. A detailed estimate of the cost of treating and conveying the wastes from Eastman Kodak to the lake is beyond the scope of this report.

Preliminary estimates indicate that a pipeline and outfall to the lake would cost approximately $8,000,000. Operating and amortization would be approximately $50,000 a year. A joint venture with the City of Rochester should be considered.

The Villages of LeRoy and Livonia should also consider transporting their waste effluents to stream locations providing sufficient dilution. LeRoy's discharge point should be relocated downstream where the stream reappears from its underground passage. Livonia must transport its effluent to Conesus outlet, a sufficient distance downstream of Lakeville's discharge to allow the stream sufficient recovery time.

H - Stream Flow Regulation

Regulation of stream flows to augment normal low flows was another quality improvement measure considered for the Genesee River basin. Table VII-4 includes a summary of the monthly gross dilution requirements for those stream sectors for which the minimum 7-consecutive-day, 1-in-10-year low flows will not provide sufficient dilution water for the 1980 and 2020 projected waste loadings to comply with water quality goals.

The projected waste loadings were computed assuming 85 percent treatment in 1980 and 90 percent in 2020. The minimum 7-consecutive-day, 1-in-10-year flow is the minimum flow or design flow within which the water quality goals should be maintained or protected.

The net dilution requirements are presented in Table IX-3 for the Genesee River below Rochester, based on the gross dilution requirements and the dependable unregulated flow. The latter is shown in terms of mean monthly flows, both for the critical water year 1963-64 and for the stated exceedance of 95 percent for the annual means of record (1949-1965) in proportion to the distribution of the medians of record for each month. The diversion pattern of Barge Canal flow to the Genesee River was changed during the 1949 Water Year.

Table IX-3

Month	Monthly Mean Flow-Ck For Stated 95% Exceedance	1963-64 Critical Water Year	Gross Dilution Requirements (cfs)	Net Dilution Requirements (cfs) 95%	1963-64
March	4210	6,815	210		
April	4840	6,740	250		
May	2460	2,090	490		
June	1150	870	780		
July	720	730	970	250	240
August	570	605	930	360	325
September	570	540	930	360	390
October	680	485	640	-	155
November	960	780	380		
December	1490	1,390	220		
January	1510	2,315	180		
February	2080	1,455	180		
			ACRE-FT. PER YEAR	58,000	66,500

NOTE: Gross dilution requirements based on maintaining 4.0 mg/l. of DO in river (See Table VI-4).

The initial investment cost of providing the 66,500 acre-feet of storage shown in Table IX-3 as yearly storage demand has been estimated by the U.S. Corps of Engineers to be about $21,300,000. The average annual cost for interest, payment on principal, and operation and maintenance was estimated at about $1,080,000. All of this draft on storage for water

quality control is needed during the months of July through November.

The dependable unregulated flows for other sectors which have not been evaluated and which should be considered for low flow augmentation, include the Genesee River below Gates-Chili-Ogden and Avon; Oatka Creek below Warsaw, Honeoye Creek below Honeoye Falls, Silver Lake Outlet below Perry, Mill Creek below Wayland, and Wilkins Creek below Livonia. In the event that flow regulation proves feasible for any or all of these sectors the monthly net dilution requirements will likewise be submitted to the Corps of Engineers.

The Soil Conservation Service has proposed six small reservoir sites for low flow augmentation. These are at Mill Creek below Wayland, Wilkins Creek below Livonia, Honeoye Creek below Honeoye Falls, Oatka Creek below Warsaw, Oatka Creek below LeRoy and Black Creek below Churchville. As pointed out previously, LeRoy and Livonia are recommended as needing effluent pipelines transferring their treated waste to points of more favorable dilution, and this remains as the recommended improvement measure for these areas. It has since been determined that Black Creek has sufficient dependable unregulated flow to handle Churchville's projected treated waste effluent.

Honeoye Falls and Warsaw appear to be sites that would benefit from development of small reservoir sites upstream. However, the average release provided available for low flow augmentation, 3.7 cfs and 1.3 cfs respectively, appears to be less than the net dilution requirements. Pending further discussions with Soil Conservation personnel on the possibility of larger release rates from these two reservoirs, it does not appear that low flow augmentation is feasible at any of the SCS sites.

In any comprehensive plan for water quality management in the Genesee Valley, an essential aspect will be not only an accurate day-to-day knowledge of streamflow amount, but also detailed forecasts of future flow in the main stem of the river and all important tributaries. These reports and forecasts would be similar to those now provided by ESSA - Weather Bureau in some areas of the nation, and could come about through an expansion of the river forecast service now provided by the Rochester Weather Bureau for the Genesee.

Abbreviations

ABS	alkyl benzene sulfonate
BOD5	5-day biochemical oxygen demand
°C	degree(s) centigrade
CCE	carbon chloroform extract
cfs	cubic feet per second
COD	chemical oxygen demand
DO	dissolved oxygen
°F	degree(s) Fahrenheit
Fig.	figure(s)
fps	feet per second
gal.	gallon(s)
gpcd	gallon(s) per capita per day
gpd	gallon(s) per day
gph	gallon(s) per hour
gpm	gallon(s) per minute
LAS	linear alkylate sulfonate
mc	microcurie(s)
mg/l.	milligram(s) per liter
mgd	million gallon(s) per day
ml	milliliter(s)
mm	millimeter(s)
MA7CD/10 yr.	minimum average consecutive 7-day flow occurring once in 10 years
MPN	most probable number(s)
pc/l.	picocurie(s) per liter
pc/ml.	picocurie(s) per milliliter
ppb	part(s) per billion
ppm	part(s) per million

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Table I-4

Past Studies

GENESEE RIVER BASIN

1. State Commission on Northwestern New York Water Supply; 1949:

   Appendix 1 - Public Water and Sewer Systems in Erie, Monroe and Genesee Counties.

   Present and Projected Water Use and Population

   Appendix 3 - Ontario County

   " 5 - Genesee County

   " 6 - Monroe and East Genesee Counties

   " 8 - Orleans, Genesee and Wyoming Counties (Tonawanda Creek and Tributaries)

   " 10 - Monroe, Ontario, Livingston and Steuben Counties

   " 14 - Supply for Rochester

2. New York State Health Department

   Water Pollution Control Board Reports

   A. Lower Genesee Basin

   B. Upper Genesee Basin

   C. Statistical Analysis of Drought Flows of Rivers of New York State

3. Reports of the Conservation Commission

   1912 - Watershed of the Genesee

   1912 - Pure Water

   1919 - Water Power Resources of the State of New York

   1929 - Water Power Resources of the State of New York

Table I-4 (Cont'd)

4. 21 States Drainage Basin

   1933 - Report of Joint Legislative Committee to Investigate Water Resources (Page 9)

5. 24 States Drainage Basin

   1959 - Report of Joint Legislative Committee on Natural Resources (Pages 150-157)

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Table I-5

Surface-water data collection sites in the Genesee River basin (all stations in New York except as noted).

Note: GS = gaging station; PR = partial-record station; Misc = miscellaneous site; CS = crest stage, LF = low flow; Res = reservoir; D = discontinued

Station number	Type of site	Stream and location
2203	Misc	Genesee River at Hickox, Pa.
2203.1	Misc	Middle Branch Genesee River at Hickox, Pa.
2203.4	Misc	West Branch Genesee River at Genesee, Pa.
2203.5	Misc	Genesee River at Genesee, Pa.
2203.7	PR, LF	Cryder Creek at Paynesville
2203.88	Misc	Marsh Creek at Stone Dam
2203.89	Misc	Marsh Creek Tributary at Mapes
2203.9	PR, LF	Marsh Creek at Mapes
2204.1	PR, LF	Ford Brook at Stannard
2204.3	PR, LF	Chenunda Creek at Stannards Corners
2204.5	PR, LF-CS	Dyke Creek near West Greenwood
2204.55	PR, LF-CS	Quig Hollow Brook near Andover
		Railroad Brook:
		Marsh Creek:
2204.6	PR, LF-CS	Marsh Creek Tributary near Andover
2204.65	PR, LF-CS	Railroad Brook near Alfred
2204.7	GS	Dyke Creek near Andover
2204.8	PR, LF-CS	Elm Valley Creek near Elm Valley
2205	GS-D; PR, LF-CS	Dyke Creek at Wellsville
2210	GS-D	Genesee River at Wellsville
2212	PR, LF	Brimmer Brook near Wellsville
2215	GS	Genesee River at Scio
2215.1	PR, LF	Vandermark Creek near Scio
2215.2	PR, LF	Knight Creek at Scio
2215.3	Misc	Gordon Brook at Scio
2215.6	PR, LF	Phillips Creek near Belmont
2216	GS (was PR, LF)	Van Campen Creek at Friendship
		Angelica Creek:
2216.5	PR, LF	Black Creek at Bennetts
2217	PR, LF	Angelica Creek near Angelica
2217.1	PR, LF	Baker Creek near Angelica
2217.2	GS	Angelica Creek at Transit Bridge
2217.6	PR, LF	White Creek near Belfast
2218	PR, LF	Black Creek at Rockville
2218.1	PR, LF	Wigwam Creek at Belfast
2218.2	GS	Genesee River at Belfast
2218.3	PR, LF	Crawford Creek at Oramel
2219	Misc	Caneadea Creek at Rushford
2219.4	Misc	Caneadea Creek Tributary at Rushford

Table I-5 (Cont'd.)

Surface-water data collection sites in the Genesee River basin (cont'd.)

Station number	Type of site	Stream and location
2219.7	Misc	Rush Creek at McGrawville
2219.9	Res	Rushford Lake
2220	GS	Caneadea Creek at Caneadea
		Cold Creek:
		Sixtown Creek:
2225	GS-D	Lost Nation Brook near Centerville
2225.15	Misc	Sixtown Creek at Hume
2225.3	PR, LF	Cold Creek at Hume
2225.35	Misc	Rush Creek near Fillmore
2225.4	PR, LF	Rush Creek at Fillmore
2226	PR, LF-CS	Wiscoy Creek at Bliss
2226.8	PR, LF	Trout Brook at Pike Corners
2227	PR, LF	Wiscoy Creek at Pike
2229	GS	East Koy Creek at East Koy
2229.3	Misc	Wiscoy Creek at Rossburg
2230	GS	Genesee River at Portageville
2234	PR, LF	Wolf Creek near Castile
2235	GS-D	Genesee River at St. Helena
2239	Res	Silver Lake
2239.5	Misc	Silver Lake Outlet near Ridge
2240	GS, Res	Mt. Morris Reservoir near Mount Morris
2245	GS-D	Genesee River at Mount Morris
		Canaseraga Creek:
2245.5	PR, LF-CS	Ewart Creek at Swain
2246.5	GS	Canaseraga Creek near Canaseraga
2247	PR, LF-CS	Sugar Creek near Ossian
2247.5	Misc	Sugar Creek near Moraine
2248	PR, LF-CS	Stony Brook at South Dansville
2248.1	PR, LF-CS	Sponable Creek near South Dansville
2248.5	Misc	Stony Brook near Stony Brook Glen
2249	PR, LF-CS	Mill Creek at Patchinville
2249.8	Misc	Mill Creek at Dansville
2250	GS	Canaseraga Creek near Dansville
2255	GS	Canaseraga Creek at Groveland
2256	PR, LF	Bradner Creek at Woodsville
		Keshequa Creek:
2259	Misc	Newville Creek near Barkertown
2260	GS-D, PR, LF	Keshequa Creek at Craig Colony, Sonyea
2265	GS-D	Keshequa Creek near Sonyea
2270	GS	Canaseraga Creek at Shakers Crossing
2275	GS	Genesee River at Jones Bridge near Mount Morris
2276	PR, LF	Beards Creek at Cuylerville
2276.5	PR, LF	Jaycox Creek near Geneseo
2279	PR, LF	Christie Creek near Canawaugus

Table I-5 (Cont'd.)

Surface-water data collection sites in the Genesee River basin (cont'd.)

Station number	Type of site	Stream and location
2279.8	GS, Res	Conesus Lake near Lakeville
2279.9	Misc	Wilkins Creek at Tuxedo Park
2279.95	Misc	Conesus Creek at Lakeville
2280	GS-D	Conesus Creek near Lakeville
2283	Misc	Conesus Creek at Ashantee
2285	GS	Genesee River at Avon
2285.2	PR, LF	White Creek at Canawaugus
2285.5	PR, LF	Dugan Creek at Maxwell
2288.45	GS	Honeoye Lake near Honeoye
2288.5	Res	Honeoye Lake at Outlet
		Honeoye Creek:
2288.55	PR, LF	Mill Creek at Honeoye Park
2289	GS	Springwater Creek at Springwater
2289.2	Res	Hemlock Lake at Outlet
		Hemlock Lake Outlet:
2289.5	GS, Res	Canadice Lake near Hemlock
2290	GS	Canadice Lake Outlet near Hemlock
2293.3	Misc	Bebee Creek at Idaho
2295	GS	Honeoye Creek at Honeoye Falls
2297	PR, LF	Spring Brook at Moran Corner
2300	GS-D	Honeoye Creek at East Rush
2300.5	PR, LF	Honeoye Creek Tributary near Rush
		Oatka Creek:
2303.1	PR, LF	Warner Creek at Rock Glen
2303.5	Misc	Oatka Creek Tributary at South Warsaw
2303.6	PR, LF	Stony Creek at Warsaw
2303.8	GS	Oatka Creek at Warsaw
2304	PR, CS	Oatka Creek at Pearl Creek
2304.1	PR, LF	Pearl Creek at Pearl Creek
2304.3	Misc	Oatka Creek near Roanoke
2304.8	Misc	Oatka Creek near Lime Rock
2304.9	PR, LF-CS	Spring Creek at Mumford
2305	GS	Oatka Creek at Garbutt
2306	Misc	Genesee River at Ballantyne Bridge near Mortimer
		Black Creek:
2307	Misc	Bigelow Creek near South Byron
2308	PR, LF	Spring Creek at Pumpkin Hill
2310	GS	Black Creek at Churchville
2310.5	PR, LF	Hotel Creek near Churchville
2311	PR, LF	Mill Creek near West Chili
2312	Misc	Black Creek near Genesee Junction
(2186.5)	Misc	Erie (Barge) Canal near Gates Center

Table I-5 (Cont'd.)

Surface-water data collection sites in the Genesee River basin (cont'd.)

Station number	Type of site	Stream and location
2314	PR, LF	Red Creek near Rochester
(2188)	Misc	Erie (Barge) Canal at West Brighton
2315	GS-D	Genesee River at Rochester
2320	GS	Genesee River at Driving Park Ave., Rochester

Table III-3

GENESEE RIVER BASIN EXCLUDING MONROE COUNTY

MUNICIPAL AND INDUSTRIAL WATER DEMANDS

Million Gallons Daily

COUNTY TOWN	1965				1980				2020			
	POP. SERVED IN GRB *	MUNICIPAL	INDUSTRIAL	TOTAL	POP. SERVED IN GRB *	MUNICIPAL	INDUSTRIAL	TOTAL	POP. SERVED IN GRB *	MUNICIPAL	INDUSTRIAL	TOTAL
ALLEGANY COUNTY												
Andover	1.24	0.11	0.04	0.15	1.24	0.12	0.06	0.18	1.24	0.15	0.08	0.23
Angelica	0.89	0.08	0.00	0.08	0.89	0.09	0.00	0.09	0.89	0.11	0.00	0.11
Amity	1.15	0.08	0.00	0.08	1.19	0.12	0.00	0.12	1.40	0.17	0.00	0.17
Belfast	0.65	0.04	0.00	0.04	0.65	0.07	0.00	0.07	0.65	0.08	0.00	0.08
Burns	0.75	0.06	0.00	0.06	0.80	0.08	0.00	0.08	0.97	0.12	0.00	0.12
Caneadea	1.12	0.10	0.00	0.10	1.16	0.12	0.00	0.12	1.34	0.16	0.00	0.16
Friendship	1.30	0.13	0.29	0.42	1.30	0.14	0.48	0.62	1.30	0.16	0.74	0.90
Hume	0.63	0.07	0.00	0.07	0.66	0.08	0.00	0.08	0.79	0.09	0.00	0.09

* Population in thousands

Table III-3 (Cont'd)

GENESEE RIVER BASIN EXCLUDING MONROE COUNTY

MUNICIPAL AND INDUSTRIAL WATER DEMANDS

Million Gallons Daily

COUNTY TOWN	1965				1980				2020			
	POP. SERVED IN GRB *	MUNICIPAL	INDUSTRIAL	TOTAL	POP. SERVED IN GRB *	MUNICIPAL	INDUSTRIAL	TOTAL	POP. SERVED IN GRB *	MUNICIPAL	INDUSTRIAL	TOTAL
ALLEGANY COUNTY (Cont'd)												
Independence	0.50	0.04	0.08	0.12	0.50	0.05	0.11	0.16	0.50	0.06	0.16	0.22
Scio	0.53	0.05	0.00	0.05	0.53	0.05	0.00	0.05	0.53	0.06	0.00	0.06
Wellsville	5.96	0.85	0.17	1.02	5.96	0.85	0.30	1.15	6.27	0.90	0.45	1.35
Willing	0.21	0.01	0.00	0.01	0.24	0.02	0.00	0.02	0.35	0.04	0.00	0.04
TOTAL	14.93	1.62	0.58	2.20	15.12	1.79	0.95	2.74	16.23	2.10	1.43	3.53

* Population in thousands

Table III-3 (Cont'd)

GENESEE RIVER BASIN EXCLUDING MONROE COUNTY

MUNICIPAL AND INDUSTRIAL WATER DEMANDS

Million Gallons Daily

COUNTY TOWN	1965				1980				2020			
	POP. SERVED IN GRB *	MUNICIPAL	INDUSTRIAL	TOTAL	POP. SERVED IN GRB *	MUNICIPAL	INDUSTRIAL	TOTAL	POP. SERVED IN GRB *	MUNICIPAL	INDUSTRIAL	TOTAL
WYOMING COUNTY												
Castile	2.36	0.18	0.01	0.19	2.91	0.31	0.01	0.32	4.13	0.52	0.01	0.53
Eagle	0.38	0.04	0.00	0.04	0.40	0.04	0.00	0.04	0.48	0.06	0.00	0.06
Gainesville	0.73	0.08	0.02	0.10	0.76	0.08	0.03	0.11	0.84	0.10	0.04	0.14
Genesee Falls	0.00	0.00	0.05	0.05	0.00	0.00	0.09	0.09	0.00	0.00	0.13	0.13
Middlebury	0.58	0.06	0.00	0.06	0.73	0.08	0.00	0.08	1.08	0.13	0.00	0.13
Perry	4.57	0.35	1.55	1.90	4.61	0.48	2.68	3.16	4.61	0.58	4.12	4.70
Pike	0.40	0.04	0.00	0.04	0.55	0.06	0.00	0.06	0.90	0.11	0.00	0.11
Warsaw	3.84	0.51	0.14	0.65	4.42	0.59	0.19	0.78	6.10	0.82	0.27	1.09
TOTAL	12.86	1.26	1.77	3.03	14.38	1.64	3.00	4.64	18.14	2.32	4.57	6.89

* Population in thousands

Table III-3 (Cont'd)

GENESEE RIVER BASIN EXCLUDING MONROE COUNTY

MUNICIPAL AND INDUSTRIAL WATER DEMANDS

Million Gallons Daily

COUNTY TOWN	1965				1980				2020			
	POP. SERVED IN GRB *	MUNICIPAL	INDUSTRIAL	TOTAL	POP. SERVED IN GRB *	MUNICIPAL	INDUSTRIAL	TOTAL	POP. SERVED IN GRB *	MUNICIPAL	INDUSTRIAL	TOTAL
GENESEE COUNTY												
Bergen	1.06	0.10	0.58	0.68	1.45	0.15	0.76	0.91	2.12	0.27	1.12	1.39
LeRoy	4.88	0.46	0.60	1.06	5.58	0.59	1.04	1.63	7.45	0.93	1.27	2.20
Pavilion	0.44	0.04	0.00	0.04	0.52	0.05	0.00	0.05	0.72	0.09	0.00	0.09
TOTAL	6.38	0.60	1.18	1.78	7.55	0.79	1.80	2.59	10.29	1.29	2.39	3.68

* Population in thousands

Table III-3 (Cont'd)

GENESEE RIVER BASIN EXCLUDING MONROE COUNTY

MUNICIPAL AND INDUSTRIAL WATER DEMANDS

Million Gallons Daily

COUNTY TOWN	1965				1980				2020			
	POP. SERVED IN GRB *	MUNICIPAL	INDUSTRIAL	TOTAL	POP. SERVED IN GRB *	MUNICIPAL	INDUSTRIAL	TOTAL	POP. SERVED IN GRB *	MUNICIPAL	INDUSTRIAL	
LIVINGSTON COUNTY												
Avon	3.67	0.46	1.00	1.46	4.65	0.60	1.33	1.93	7.31	0.96	1.94	2.90
Caledonia	2.12	0.17	0.02	0.19	2.83	0.30	0.03	0.33	5.08	0.64	0.05	0.69
Geneseo	3.54	0.43	0.08	0.51	4.35	0.54	0.14	0.68	6.34	0.79	0.21	1.00
Groveland	0.00	0.00	0.02	0.02	0.00	0.00	0.02	0.02	0.00	0.00	0.04	0.04
Leicester	0.37	0.04	0.00	0.04	0.38	0.04	0.00	0.04	0.42	0.05	0.00	0.05
Lima	1.50	0.16	0.00	0.16	1.91	0.22	0.00	0.22	3.01	0.38	0.00	0.38
Livonia	3.00	0.25	0.22	0.47	6.73	0.37	0.29	0.66	6.73	0.69	0.42	1.11
Mt. Morris	3.18	0.49	0.10	0.59	3.18	0.49	0.13	0.62	3.18	0.49	0.19	0.68

* Population in thousands

Table III-3 (Cont'd)

GENESEE RIVER BASIN EXCLUDING MONROE COUNTY

MUNICIPAL AND INDUSTRIAL WATER DEMANDS

Million Gallons Daily

COUNTY TOWN	1965				1980				2020			
	POP. SERVED IN GRB *	MUNICIPAL	INDUSTRIAL	TOTAL	POP. SERVED IN GRB *	MUNICIPAL	INDUSTRIAL	TOTAL	POP. SERVED IN GRB *	MUNICIPAL	INDUSTRIAL	TOTAL
LIVINGSTON COUNTY (Cont'd)												
North Dansville	5.62	1.03	0.45	1.48	6.17	1.03	0.79	1.82	7.48	1.03	1.21	2.24
Nunda	1.23	0.11	0.03	0.14	1.26	0.13	0.03	0.16	1.32	0.15	0.05	0.20
Springwater	0.19	0.02	0.05	0.07	0.19	0.02	0.06	0.08	0.19	0.02	0.09	0.11
York	1.40	0.13	0.07	0.20	1.72	0.18	0.10	0.28	2.50	0.31	0.16	0.47
TOTAL	25.82	3.29	2.04	5.33	33.37	3.92	2.92	6.84	43.56	5.51	4.36	9.87

*Population in thousands

Table III-3 (Cont'd)

GENESEE RIVER BASIN EXCLUDING MONROE COUNTY

MUNICIPAL AND INDUSTRIAL WATER DEMANDS

Million Gallons Daily

COUNTY TOWN	1965				1980				2020			
	POP. SERVED IN GRB *	MUNICIPAL	INDUSTRIAL	TOTAL	POP. SERVED IN GRB *	MUNICIPAL	INDUSTRIAL	TOTAL	POP. SERVED IN GRB *	MUNICIPAL	INDUSTRIAL	TOTAL
ONTARIO COUNTY												
Richmond	0.60	0.06	1.00	1.06	1.00	0.12	1.33	1.45	2.10	0.26	1.94	2.20
TOTAL	0.60	0.06	1.00	1.06	1.00	0.12	1.33	1.45	2.10	0.26	1.94	2.20
STEUBEN COUNTY												
Wayland	2.10	0.20	0.01	0.21	2.29	0.24	0.01	0.25	2.45	0.29	0.01	0.30
TOTAL	2.10	0.20	0.01	0.21	2.29	0.24	0.01	0.25	2.45	0.29	0.01	0.30
POTTER COUNTY, PA.												
Genesee	0.50	0.03	0.00	0.03	0.50	0.03	0.00	0.03	0.50	0.03	0.00	0.03
Ulyses	0.60	0.03	0.00	0.03	0.60	0.03	0.00	0.03	0.60	0.03	0.00	0.03
TOTAL	1.10	0.06	0.00	0.06	1.10	0.06	0.00	0.06	1.10	0.06	0.00	0.06

* Population in thousands

Table III-4

Genesee River Basin

WATER SUPPLY INVENTORY

ALLEGANY COUNTY

COMMUNITY	1960 POPULATION	ESTIMATED POPULATION SERVED (%)	SOURCE OF SUPPLY	TREATMENT
Rushford (H)	63	NO PUBLIC WATER SUPPLY		
Belmont (V)	1,146	100%	Ground	Aeration, pressure sand filtration, softening
Andover (V)	1,275	100%	Ground	Chlorination
Angelica (V)	898	100%	Ground	None
Canaseraga (V)	730	100%	Ground	None
Friendship (V)	1,231	100%	Ground	Aeration, chlorination
Nile	100			
Fillmore (V)	522	90%	Ground	Softening, chlorination
(3 systems serve village)		Unknown	Ground	None
		Unknown	Ground	None
Belfast (H)	650	100%	Ground	Aeration, sedimentation, D.E. filter, softening
Houghton (H) College owned supply	1,100 (inc. college)		Ground	Well softened Spring - none
Hume (H)	100	Unknown	Unknown	None
(2 systems serve hamlet)		Unknown	Ground	None

Table III-4 (cont'd)

Genesee River Basin

WATER SUPPLY INVENTORY

ALLEGANY COUNTY

COMMUNITY	1960 POPULATION	ESTIMATED POPULATION SERVED (%)	SOURCE OF SUPPLY	TREATMENT
Whitesville (H)	500	100%	Ground	Chlorination
Scio (H)	532	90%	Ground	None
Stannards (H)	200	100%	Ground	None
Wellsville (V)	5,967	100%	Genesee River	Coagulation, sedimentation, filtration, chlorination, taste and odor and corrosion control

Table III-4 (cont'd)

Genesee River Basin

WATER SUPPLY INVENTORY

ALLEGANY COUNTY - OUTSIDE GENESEE BASIN

COMMUNITY	1960 POPULATION	ESTIMATED POPULATION SERVED (%)	SOURCE OF SUPPLY	TREATMENT
Bolivar (V)	1,405	100%	Ground	Iron and Mn removal, softening, corrosion control, chlorination
Cuba (V)	1,949	100%	Ground	South well and springs - chlorination North well - aeration, filtration, chlorination
Richburg (V)	493	100%	Ground	None

Table III-4 (cont'd)

Genesee River Basin

WATER SUPPLY INVENTORY

GENESEE COUNTY

COMMUNITY	1960 POPULATION	ESTIMATED POPULATION SERVED (%)	SOURCE OF SUPPLY	TREATMENT
Byron (H)	450	NO PUBLIC WATER SUPPLY		
LeRoy (V)	4,662	100%	Mud, Little Beards and Oatka Crs.; also Silver Lake from 9/15 to 5/15 if lake is at or above stated level	Aeration, coagulation, sedimentation, filtration, chlorination, taste and odor control
Bergen (V)	964	100%	Ground	Chlorination
Pavilion (H) Private Water Co.	400 (in water district)	100%	Ground	Chlorination
Stafford (H)	150	NO PUBLIC WATER SUPPLY		

Table III-4 (cont'd)

Genesee River Basin

WATER SUPPLY INVENTORY

LIVINGSTON COUNTY

COMMUNITY	1960 POPULATION	ESTIMATED POPULATION SERVED (%)	SOURCE OF SUPPLY	TREATMENT
Geneseo (V) York (H) Retsof S. D. + college	3,284 1,100 200 College: Projected 1970 enrollment 3,600	100%	Conesus Lake	Micro-strainers, Chlorination Fluoridation
Nunda (V)	1,224	100%	Little Dansville Creek	Coagulation, sedimentation, filtration, chlorination
Conesus (H)	350	NO PUBLIC WATER SUPPLY		
Groveland Station (H)	500	NO PUBLIC WATER SUPPLY		
South Lima (H)	250	NO PUBLIC WATER SUPPLY		
Dalton (H)	750	NO PUBLIC WATER SUPPLY		
Springwater (H) Springwater Water Co.	200	67%	Ground	Chlorination
Livonia (V) S. Livonia	946 140	100%	Marrowback Creek	Coagulation, sedimentation, filtration, chlorination
Caledonia (V) Mumford	1,917 600	100%	Ground	None
Lima (V)	1,366	100%	Ground	Chlorination and corrosion control
Lakeville (H)	1,200	100%	Conesus Lake	Chlorination

Table III-4 (cont'd)

Genesee River Basin

WATER SUPPLY INVENTORY

LIVINGSTON COUNTY

COMMUNITY	1960 POPULATION	ESTIMATED POPULATION SERVED (%)	SOURCE OF SUPPLY	TREATMENT
Avon (V)	2,772	100%	Conesus Lake	Chlorination
E. Avon	600			
Mt. Morris (V)	3,250	100%	Silver Lake and auxiliary springs	Coagulation, sedimentation, filtrations, chlorination
Leicester (V)	365			
Cuylerville (H)	360			
Dansville (V)	5,460	100%	Little Mill Creek and two new wells	Surface - plain sedimentation, chlorination Wells - chlorination

Table III-4 (cont'd)

Genesee River Basin

WATER SUPPLY INVENTORY

ONTARIO COUNTY

COMMUNITY	1960 POPULATION	ESTIMATED POPULATION SERVED (%)	SOURCE OF SUPPLY	TREATMENT
Honeoye (H)	500	100%	Ground	None
W. Bloomfield (H)	500	NO PUBLIC WATER SUPPLY		

Table III-4 (cont'd)

Genesee River Basin

WATER SUPPLY INVENTORY

STEUBEN COUNTY

COMMUNITY	1960 POPULATION	ESTIMATED POPULATION SERVED (%)	SOURCE OF SUPPLY	TREATMENT
Wayland (V)	2,003	100%	Ground	Chlorination

Table III-4 (cont'd)

Genesee River Basin

WATER SUPPLY INVENTORY

WYOMING COUNTY

COMMUNITY	1960 POPULATION	ESTIMATED POPULATION SERVED (%)	SOURCE OF SUPPLY	TREATMENT
Gainesville (V)	369	NO PUBLIC WATER SUPPLY		
Portageville (H)	300	NO PUBLIC WATER SUPPLY		
Castile (V)	1,146	100%	Ground	Chlorination
Silver Springs (V)	726	100%	Ground	Chlorination
Wyoming (V)	526	100%	Ground	Chlorination
Pike (V)	345	100%	Ground	None
Bliss (H)	375	100%	Ground	Chlorination
Perry (V) Perry Center (H) Silver Lake (H) Letchworth State Park	4,629 350 1,000 -----	100%	Silver Lake	Coagulation, sedimentation, filtration, chlorination
Warsaw (V)	4,053	100%	Oatka Creek	Coagulation, sedimentation, filtration, chlorination

Table VI-1

DESCRIPTION OF SAMPLING STATIONS

Genesee River Basin

1964 - 1965

STREAM OR INLAND LAKE	STATION MILEAGE	STATION LOCATION
Angelica Creek Ont. 117-155	0.5	County Road 43 Bridge 1.5 mile west of Angelica
Barge Canal 1 BC		Chili Avenue Bridge (Route 33A) in Rochester
2 BC		Brooks Avenue Bridge in Rochester
3 BC		Scottsville Road Bridge (Route 383) in Rochester
4 BC		Footpath Bridge in Genesee Valley Park, Rochester
5 BC		Extension of River Blvd. in Genesee Valley Park
6 BC		West Henrietta Road Bridge (U.S. Route 15) in Rochester
7 BC		East Henrietta Road Bridge in Rochester
8 BC		Clinton Avenue Bridge in Rochester
Black Creek Ont. 117-19	0.0	New York State Route 383 Bridge
	2.8	Archer Road Bridge
	3.8	Beaver Road Bridge
	6.85	Chili Road Bridge
	8.55	Stottle Road Bridge
	10.15	Union Street Bridge near West Chili
	11.20	Buckbee Corners Road Bridge
	12.80	Small private truss bridge

Table VI-1 (cont'd)

DESCRIPTION OF SAMPLING STATIONS

Genesee River Basin

1964 - 1965

STREAM OR INLAND LAKE	STATION MILEAGE	STATION LOCATION
Black Creek (cont'd)	13.80	Attridge Road Bridge
	15.95	Burnt Mill Road Bridge
	18.10	Wading Station downstream of Buffalo Road Bridge
	19.20	North Main Street Bridge in Churchville Park
	22.40	Route 19 Bridge
	25.90	West Sweden Road Bridge
Canaseraga Creek Ont. 117-66	1.1	Route 408 Bridge 1.5 mile northeast of Mt. Morris
	9.9	D. L. & W. Railroad Bridge 0.5 mile north of Groveland Station
	10.9	Route 258 Bridge in Groveland Station
	14.2	Private bridge approximately 4 miles northwest of Dansville along Route 63
	16.4	Private bridge 2 miles north of Dansville along Route 63
	18.2	Route 36 Bridge at Cummingsville
	19.3	Route 245 Bridge downstream of Dansville
	23.5	Poagehole Road Bridge one mile southwest of Stony Brook State Park
Caneadea Creek Ont. 117-40	0.25	Route 19 Bridge 0.2 mile south of Caneadea

Table VI-1 (cont'd)

DESCRIPTION OF SAMPLING STATIONS

Genesee River Basin

1964 - 1965

STREAM OR INLAND LAKE	STATION MILEAGE	STATION LOCATION
Conesus Outlet Ont. 117-40	1.9	Route 39 Bridge south of Avon
	4.0	Paper Mill Road Bridge
	6.6	Pole Bridge Road Bridge near Lakeville
	8.5	Route 256 Bridge
	9.8	Wading station 0.3 mile north of intersection of Rts. 15 and 20A
	10.1	Wading station downstream from U. S. Rt. 20A Bridge in Lakeville
	10.2	Wooden Bridge over Outlet immediately downstream of Conesus Lake
Dyke Creek Ont. 117-184	0.3	South Main Street (Rt. 19) Bridge in Wellsville
	6.0	Bay Hill Road Bridge east of Elm Valley
	8.0	Abandoned Route 17 Bridge southwest of Andover
	10.4	County Road No. 22 Bridge east of Andover
East Koy Creek	0.8	Single lane bridge northwest of Wiscoy
	2.4	East Koy Road Bridge east of East Koy
	6.5	Route 39 Bridge in Lamont
	9.8	School Road Bridge southeast of Gainsville
	15.0	Route 78 Bridge in Hermitage

Table VI-1 (cont'd)

DESCRIPTION OF SAMPLING STATIONS

Genesee River Basin

1964 - 1965

STREAM OR INLAND LAKE	STATION MILEAGE	STATION LOCATION
Genesee River Ont. 117	0.0	Boat sampling station at Stutson Street in Rochester
	0.8	Boat sampling station at Stutson Street in Rochester
	2.0	Boat station at Rattlesnake Point in Rochester
	2.60	Boat sampling station above coal docks
	3.85	Boat sampling station near St. Bernard's Seminary
	5.05	Boat sampling station at Memorial Bridge in Rochester
	5.80	Boat sampling station upstream of Memorial Bridge
	6.90	N.Y. Central Railroad Bridge in Rochester
	7.20	Driving Park Rd. Bridge in Rochester
	7.55	Platt Street Bridge in Rochester
	7.85	Andrews Street Bridge in Rochester
	8.20	Broad Street Bridge in Rochester
	8.36	Dam walkway over Barge Canal Spur in Rochester
	9.00	Clarissa Street Bridge in Rochester
	9.90	Erie Railroad Bridge in Rochester
	11.00	Elmwood Avenue Bridge in Rochester

Table VI-1 (cont'd)

DESCRIPTION OF SAMPLING STATIONS

Genesee River Basin

1964 - 1965

STREAM OR INLAND LAKE	STATION MILEAGE	STATION LOCATION
Genesee River (cont'd) Ont. 117	11.52	Boat Sampling station at Barge Canal confluence
	14.3	N. Y. Central Railroad Bridge
	14.6	Ballantyne Road (Route 252) Bridge upstream of Black Creek confluence
	21.5	Browns Road (Route 253) Bridge downstream of Oatka Creek confluence
	23.8	Rush Road (Route 251) Bridge downstream of Honeoye Creek confluence
	34.7	Routes 5 and 20 Bridge 0.1 mile west of Avon
	40.3	Fowlerville Road Bridge one mile east of Fowlerville
	52.8	Route 63 Bridge upstream of Geneseo Sewage Treatment Plant
	60.7	Routes 20A and 39 Bridge 1.5 miles east of Cuylerville
	61.9	Jones Road Bridge 1 mile downstream of Canaseraga Creek
	65.5	Route 36 Bridge northwest of Mount Morris
	88.0	Route 245 Bridge at Portageville
	89.5	Bolton Road Bridge
	100.6	East Main Street Bridge in Fillmore
	103.0	Town Road Bridge 1.5 miles north of Houghton

Table VI-1 (cont'd)

DESCRIPTION OF SAMPLING STATIONS

Genesee River Basin

1964 - 1965

STREAM OR INLAND LAKE	STATION MILEAGE	STATION LOCATION
Genesee River (cont'd)	107.8	Single lane bridge 1 mile north of Caneadea
	114.4	East Hughs Street Bridge east of Belfast
	119.5	Route 408 Bridge 3 miles southeast of Belfast
	124.2	County Road 20 Bridge 1 mile northeast of Belvidere
	127.9	Route 19 Bridge in Belmont
	129.4	Single lane bridge 1 mile south of Belmont
	133.2	County Road 9 Bridge in Scio
	135.2	Wading Station 1.5 miles downstream of Wellsville
	137.7	Route 17 Bridge in Wellsville, 0.5 mile downstream of Dyke Creek
	138.9	Southernmost Bridge in Wellsville above confluence with Dyke Creek
	140.4	Weidrich Road Bridge 1.5 miles upstream of Wellsville
	142.3	Stannard Road Bridge
	144.6	Route 29 Bridge at York Corners
	147.9	Route 19 Bridge at Shongo
Honeoye Creek Ont. 117-27	0.1	Erie Railroad Bridge 5 miles north of Avon
	1.4	Route 253 Bridge

Table VI-1 (cont'd)

DESCRIPTION OF SAMPLING STATIONS

Genesee River Basin

1964 - 1965

STREAM OR INLAND LAKE	STATION MILEAGE	STATION LOCATION
Honeoye Creek (cont'd) Ont. 117-27	4.1	Route 15 Bridge
	7.4	Wading station downstream of Route 15A Bridge in Rush
	10.2	Plains Road Bridge
	12.4	Sibley Road Bridge
	13.5	Lehigh Valley Railroad Bridge
	14.0	Wading station downstream from Honeoye Falls Sewage Treatment Plant
	16.3	Route 65 Bridge in Honeoye Falls
	20.6	Routes 5 and 20 Bridge
	28.8	County Road No. 37 Bridge
	33.7	Route 20A Bridge at Honeoye just downstream of Honeoye Lake
Keshequa Creek Ont. 117-66-3	1.3	Wading station north of Sonyea
	2.4	Craig Colony Road Bridge at Sonyea
	7.6	Single lane bridge that intersects with Route 258
	10.4	Coopersville Road Bridge 1 mile east of Route 408
	13.0	Walnut Street Bridge in Nunda
	13.6	Route 408 Bridge in Nunda
	15.2	Bridge at Oakland carrying unnamed road from Oakland to Dalton

Table VI-1 (cont'd)

DESCRIPTION OF SAMPLING STATIONS

Genesee River Basin

1964 - 1965

STREAM OR INLAND LAKE	STATION MILEAGE	STATION LOCATION
Keshequa Creek (cont'd)	16.5	Bridge carrying unnamed road from Oakland to Hunt approximately 1.1 miles north of Hunt
Knight Creek Ont. 117-175	0.2	County Road 9 Bridge in Scio
South McMillan Creek Ont. 117-40-P67-10-2	6.4	May Road Bridge over creek in Webster's Crossing
Mill Creek Ont. 117-66-22	0.5	Route 36 Bridge in Dansville
	1.6	Mill Creek Treatment Plant Bridge
	2.7	Stone Falls Road Bridge
	5.2	D. L. & W. Railroad Bridge west of Perkinsville
	5.6	Bridge southeast of Perkinsville
	6.1	Inlet Road Bridge east of Perkinsville
	7.4	Single lane road 0.3 mile west of Route 21
Oatka Creek Ont. 117-25	1.0	Canawaugus Road Bridge
	1.4	Route 251 Bridge in Scottsville
	4.2	Union Street Bridge in Scottsville
	7.9	State Street Bridge in Mumford
	14.40	Circular Hill Road Bridge
	18.16	N.Y.C. & B&O Railroad Bridge in LeRoy

Table VI-1 (cont'd)

DESCRIPTION OF SAMPLING STATIONS

Genesee River Basin

1964 - 1965

STREAM OR INLAND LAKE	STATION MILEAGE	STATION LOCATION
Oatka Creek (cont'd)	18.30	Pedestrian Bridge in LeRoy
	18.80	Route 19 Bridge in LeRoy
	21.10	Cole Road Bridge 1.5 miles southwest of Village of LeRoy
	25.90	Route 20 Bridge
	28.80	Route 63 Bridge
	32.90	Route 19 Bridge near Wyoming
	36.60	Sherman Avenue Bridge in Wyoming
	38.10	School Road Bridge in Wyoming
	44.10	Route 19 Bridge near Warsaw
	45.80	Single lane bridge near Warsaw
	46.90	Court Street Bridge in Warsaw
	47.20	Route 20A Bridge in Warsaw
	47.50	Allen Street Bridge in Warsaw
	49.40	Keeney Road Bridge upstream of Warsaw
Red Creek Ont. 117-14	0.01	Footbridge in Genesee Valley Park
	0.35	Hawthorne Drive Bridge in Genesee Valley Park
	1.20	Crittenden Road Bridge
	2.10	Jefferson Road Bridge
	3.5	Route 15 Bridge

Table VI-1 (cont'd)

DESCRIPTION OF SAMPLING STATIONS

Genesee River Basin

1964 - 1965

STREAM OR INLAND LAKE	STATION MILEAGE	STATION LOCATION
Red Creek (cont'd)	3.5	Wading station near N. Y. Thruway crossing
	4.6	Calkins Road Bridge
Silver Lake Outlet Ont. 117-70	1.25	Park Road Bridge in Letchworth State Park
	3.10	Single lane bridge 1.75 miles southeast of Perry
	5.40	Gardean Street Bridge in Perry
	6.70	Lake Road Bridge adjacent to Silver Lake
Van Campen Creek Ont. 117-64	0.5	Route 19 Bridge in Belvidere
	2.5	Wading station downstream of Friendship
	4.0	Wading station downstream of Friendship
	4.6	Wading station near Friendship dairy
	5.7	W. Water St. Bridge in Friendship
Wilkins Creek Ont. 117-40-P67-2	0.2	County Road No. 6 (E. Lake Road) Bridge
	1.0	Single lane bridge to Livonia Treatment Plant
Wiscoy Creek Ont. 117-104	1.5	Route 19A Bridge
	2.5	Bridge in Wiscoy

Table VI-1 (cont'd)

DESCRIPTION OF SAMPLING STATIONS

Genesee River Basin

1964 - 1965

STREAM OR INLAND LAKE	STATION MILEAGE	STATION LOCATION
Wiscoy Creek (cont'd)	6.0	Single lane bridge 0.8 mile west of Mills
	9.4	Camp Sam Wood Road Bridge
	13.1	Route 39 Bridge in Pike
	16.7	Route 39 Bridge 1.4 mile west of Pike Corners
	19.5	Route 362 Bridge in Bliss
Wolf Creek Ont. 117-87	0.25	Park Road Bridge in Letchworth State Park
	2.60	Park Road East Bridge in Castile
	4.4	County Road 23 (Barber Road) Bridge
	5.7	Perry Avenue East Bridge in Silver Springs

Table VI-2

ANALYTICAL RESULTS - 1964-65
GENESEE RIVER BASIN
All values are in mg/l unless otherwise indicated

STREAM MILEAGE	DATE COLLECTED	TEMPERATURE °C	pH	CONDUCTIVITY u mhos/cm	ALKALINITY	TURBIDITY	DO	BOD-5 DAY	NITROGENS			TOTAL PHOSPHATES	SOLIDS		CHLORIDES	SULFATES	SILICON DIOXIDE	MANGANESE	IRON	ABS	FLUORIDES	COLIFORMS MPN
									NH_3	NO_3	ORGANIC		TOTAL	SUSPENDED								
									OATKA CREEK ONT. 117-25													
0.2	9/29/64	8.0	7.4	1080	191	3	7.0	0.8							38							930
1.0	4/15/65	6.5	8.2	620	122		12.7	1.2	0.26	1.10					35							
	7/13/65	17.5	7.9	580	161		7.2	1.7	0.23	1.30					59							
	9/23/65	21.5	7.9	1400	191	2.9	5.9	2.8	0.18	0.20					12							
1.4	7/16/64	20	8.1				9.2	1.4														
	9/28/64	11.0	7.9	1295	188	3	9.6	1.8							46							110,000
4.2	7/16/64	19.0	8.1				10.7	1.2														
	9/28/64	10.0	7.9	1330	188	3	9.2	0.6	0.03	0.3	0.22	0.3	1271	14	44	540	6.3	<0.01	0.11	0.02	0.05	150
7.9	7/16/64	17.0	7.7				8.5	0.8														
	9/25/64	13.0	7.9	1190	192	2	9.2	1.0	0.03	0.08	0.20	0.1	1068	5	34							1,500
14.4	7/16/64	13.0	7.1				2.8	0.9														
18.18	7/15/64	23.5	8.0				7.3	2.9														
	9/25/64	13.0	7.7	468	123	5	8.6	3.4	0.36	0.04	0.95	0.9	296	7	55							230,000
18.8	7/15/64	22.0	7.6				3.9	2.5														
19.55	9.25.64	14	7.6	441	107	25	6.8	1.2				0.3			58	37						2,300

Table VI-2

ANALYTICAL RESULTS - 1964-65
GENESEE RIVER BASIN
All values are in mg/l unless otherwise indicated

STREAM MILEAGE	DATE COLLECTED	TEMPERATURE °C	pH	CONDUCTIVITY u mhos/cm	ALKALINITY	TURBIDITY	DO	BOD-5 DAY	NITROGENS			TOTAL PHOSPHATES	SOLIDS		CHLORIDES	SULFATES	SILICON DIOXIDE	MANGANESE	IRON	ABS	FLUORIDES	COLIFORMS MPN
									NH_3	NO_3	ORGANIC		TOTAL	SUSPENDED								
GENESEE RIVER ONT. 117																						
0.0	6/23/64	22	7.9				7.1															
	7/28/64	22	7.8	355			6.3	3.6														
0.7	6/23/64	26	7.6				4.3															
	7/28/64	23	7.5	400			3.2	4.5														
	10/7/64	16	7.2	512	118	3	1.0	6.5	0.38	0.06	1.12	0.3	362	11	56	72	1.1	0.15	0.38	0.11	0.30	9,300
1.90	6/23/64	25	7.6				3.6															
	7/28/64	26	7.4	435			0.8	6.6														
	10/7/64	16	7.1	522	116	6	0.3	9.9							58							
2.57	6/23/64	26	7.5				3.0															
	7/28/64	28	7.4	460			0.8	6.8														
	10/7/64	16	7.2	550	113	9	0.2	23.6	1.1	0.02	1.85	0.3	391	13	53							750.000
4.17																						
4.17	6/23/64	25	7.7				5.8															
	7/28/64	29	7.4	500			1.3	7.8														
	10/7/64	16	7.2	490	110	12	3.4	12.3							52							750,000
5.05	6/23/64	26	7.9				7.9															
	7/28/64	30	7.6	500			4.0	2.8														
	10/7/64	15	7.3	480	111	9	7.2	3.2	0.11	0.06	0.84	0.6	338	23	47	70	1.3	0.12	0.88	0.06	0.20	23,000

Table VI-2

ANALYTICAL RESULTS - 1964-65
GENESEE RIVER BASIN
All values are in mg/l unless otherwise indicated

STREAM MILEAGE	DATE COLLECTED	TEMPERATURE °C	pH	CONDUCTIVITY u mhos/cm	ALKALINITY	TURBIDITY	DO	BOD-5 DAY	NITROGENS			TOTAL PHOSPHATES	SOLIDS		CHLORIDES	SULFATES	SILICON DIOXIDE	MANGANESE	IRON	ABS	FLUORIDES	COLIFORMS MPN
									NH_3	NO_3	ORGANIC		TOTAL	SUSPENDED								
GENESEE RIVER ONT. 117 (Contd)																						
5.80	6/23/64	26	7.9				8.0															
	7/28/64	29	7.7				5.0	2.7														9,300
5.95	10/7/64	15	7.3	488	108	9	7.4	3.2							49							15,000
7.86	7/23/64	27	8.2	488			8.9	3.5														
	10/5/64	15	7.4	505	112	8	6.8	2.0	0.2	0.06	0.56	0.5	354	16	52	75	1.1					
	10/7/64																	0.12	0.59	0.04	0.25	
8																						
8.20	6/16/64	21	7.4				7.0															
	7/23/64	27	8.4	485			9.8	4.0														750
8.36	6/16/64	20	7.7				7.2															
	7/23/64	27	8.4	490			9.8															
	10/5/64	14	7.3	515	110	8	6.0	2.2							51							3,900
9.0	6/16/64	21	7.7				6.4															
	7/23/64	27	8.2	488			9.2	3.3														
	4/13/65	5.0	8.1	360	79		11.0	5.4	0.08	0.50					40							
	7/14/65	21.0	7.7	520	128		7.6	4.0	0.24	0.28					64							
	9/23/65	22.5	7.8	560	99	3.0	5.9	4.0	0.28	1.20					32							
9.90	9/16/64	21	7.7				6.4															
	7/23/64	26	8.0	500			7.8	2.5														

Table VI-2

ANALYTICAL RESULTS - 1964-65
GENESEE RIVER BASIN
All values are in mg/l unless otherwise indicated

STREAM MILEAGE	DATE COLLECTED	TEMPERATURE °C	pH	CONDUCTIVITY u mhos/cm	ALKALINITY	TURBIDITY	DO	BOD-5 DAY	NITROGENS			TOTAL PHOSPHATES	SOLIDS		CHLORIDES	SULFATES	SILICON DIOXIDE	MANGANESE	IRON	ABS	FLUORIDES	COLIFORMS MPN
									NH_3	NO_3	ORGANIC		TOTAL	SUSPENDED								
GENESEE RIVER ONT. 117 (Contd)																						
11.00	6/16/64	21	7.7				6.6															
	7/23/64	26	8.0	515			7.9	2.8														
	10/5/64	14	7.3	513	110	6	5.8	2.0	0.17	0.06	0.78	0.6	332	11	50							2,300
14.0	4/19/65	2.0	8.3	340	70			1.9							114							
	9/23/65	2.3	8.1	800	123	4	5.8	3.5	0.24	0.60					21							
14.3	6/16/64	21	8.0				9.3															
	7/21/64	28	8.2	655			9.7	3.1														430
14.6	6/16/64	21	8.1				9.2															
	10/14/64	10	7.6	890	135	6	5.6	2.2							120							2,300
21.50	6/16/64	21	8.0				9.4															
	7/21/64	28	8.0	650			8.4	3.0														9,300
23.80	6/16/64	21	7.8				8.2															
	7/21/64	28	8.1	600			8.6	3.2														
	10/14/64	9	7.6	825	141	9	6.0	2.2							128							24,000
34.70	6/12/64	20	7.9				6.8															
	7/21/64	28	8.0	500			6.2	1.6														930
	10/14/64	9	7.7	618	147	5	6.8	2.9	0.03	0.04	0.56	0.3	377	16	92							93,000

Table VI-2

ANALYTICAL RESULTS - 1964-65
GENESEE RIVER BASIN
All values are in mg/l unless otherwise indicated

STREAM MILEAGE	DATE COLLECTED	TEMPERATURE °C	pH	CONDUCTIVITY u mhos/cm	ALKALINITY	TURBIDITY	DO	BOD-5 DAY	NITROGENS			TOTAL PHOSPHATES	SOLIDS		CHLORIDES	SULFATES	SILICON DIOXIDE	MANGANESE	IRON	ABS	FLUORIDES	COLIFORMS MPN
									NH_3	NO_3	ORGANIC		TOTAL	SUSPENDED								
GENESEE RIVER ONT. 117 (Contd)																						
34.70	4/15/65	7.0	7.4	240	182		11.5	3.5	0.09	0.35					76							
	7/14/65	25	8.2	460	117		7.4	5.7	0.37	1.42					71							
	9/30/65	14.0	6.9	560	119		5.0	15.0	0.34	0.52					50							
40.3	6/12/64	21	7.7				6.8															
	7/21/64	27	7.8				5.6															
52.80	6/12/64	20	7.9				7.0															
	7/21/64	28	8.0	430			5.8	1.7														7,500
	10/14/64	11	7.9	600	140	6	8.8	6.6	0.01	0.04	0.56	0.3	407	27	98							46,000
60.70	6/12/64	20	7.9				7.8															
	7/21/64	26	7.8				4.6															
66.50	6/12/64	21	8.2				8.4															
	7/21/64	27	8.2	410			6.8	1.4														93
88.00	6/12/64	20	8.1				7.6															
	7/22/64	27	8.2	285			6.8	1.0														150
89.507	6/12/64	20	8.1				8.0															
	7/22/64	28	8.1				7.4															
	10/15/64	13	8.0	330	110	9	10.8	0.6							24							

Table VI-2

ANALYTICAL RESULTS - 1964-65
GENESEE RIVER BASIN
All values are in mg/l unless otherwise indicated

STREAM MILEAGE	DATE COLLECTED	TEMPERATURE °C	pH	CONDUCTIVITY u mhos/cm	ALKALINITY	TURBIDITY	DO	BOD-5 DAY	NITROGENS			TOTAL PHOSPHATES	SOLIDS		CHLORIDES	SULFATES	SILICON DIOXIDE	MANGANESE	IRON	ABS	FLUORIDES	COLIFORMS MPN
									NH_3	NO_3	ORGANIC		TOTAL	SUSPENDED								
GENESEE RIVER ONT. 117 (Contd)																						
100.60	5/17/64	21	8.1				9.2															
	7/27/64	26	8.1	275			7.2	1.0														2,300
103.00	5/17/64	21	8.1				9.6															
107.80	5/17/64	21	8.1				9.6															
114.40	5/17/64	20	7.9				9.4															
	7/22/64	26	7.6	270			6.8	1.2														430
119.50	6/17/64	19	7.8				9.6															
124.20	6/17/64	19	7.7				9.4															
	7/22/64	25	7.2				6.2															
	10/15/64	13	7.7	335	73	2	9.6	0.4	0.01	0.02	017	0.5	211	4	51							2,300
127.70	6/17/64	18	8.2				9.8															
	7/22/64	23	7.8				7.6															
127.90	6/17/64	19	7.9				9.2															
	7/22/64	23	7.5	285			7.4	1.8														430
129.40	6/17/64	19	8.4				10.8															
	7/22/64	25	8.4				10.2															430

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ANALYTICAL RESULTS - 1964-65
GENESEE RIVER BASIN
All values are in mg/l unless otherwise indicated

STREAM MILEAGE	DATE COLLECTED	TEMPERATURE °C	pH	CONDUCTIVITY u mhos/cm	ALKALINITY	TURBIDITY	DO	BOD-5 DAY	NITROGENS			TOTAL PHOSPHATES	SOLIDS		CHLORIDES	SULFATES	SILICON DIOXIDE	MANGANESE	IRON	ABS	FLUORIDES	COLIFORMS MPN
									NH_3	NO_3	ORGANIC		TOTAL	SUSPENDED								
GENESEE RIVER ONT. 117 (Contd)																						
133.20	6/17/64	17	7.5				8.4															
	7/22/64	26	7.7				7.4	3.6														
	10/15/65	13	7.3	280	69	2	7.4	1.2							34							930
135.20	6/17/64	17	7.5				9.0															
	7/22/64	26	7.6	225			6.0	4.4														15,000
137.70	6/17/64	18	7.9				10.6															
	7/22/64	27	8.1				9.0															2,300
	10/15/64	10	7.7	230	67	2	11.6	0.6	0.01	0.04	0.22	0.5	146	4	25							
138.9	6/17/64	17	7.7				9.8															
	7/22/64	26	7.6				8.2															
140.4	6/17/64	16	7.5				9.2															
	7/22/64	25	7.7				7.4	1.2														4,300
142.30	6/17/64	16	7.7				9.0															
144.60	6/17/64	16	7.7				9.2															
	7/22/64	25	7.7	125			7.2	1.8														1,500
	10/15/64	9	7.7	139	47	2	10.0	0.2							9							93

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ANALYTICAL RESULTS - 1964-65
GENESEE RIVER BASIN
All values are in mg/l unless otherwise indicated

STREAM MILEAGE	DATE COLLECTED	TEMPERATURE °C	pH	CONDUCTIVITY u mhos/cm	ALKALINITY	TURBIDITY	DO	BOD-5 DAY	NITROGENS			TOTAL PHOSPHATES	SOLIDS		CHLORIDES	SULFATES	SILICON DIOXIDE	MANGANESE	IRON	ABS	FLUORIDES	COLIFORMS MPN
									NH_3	NO_3	ORGANIC		TOTAL	SUSPENDED								
GENESEE RIVER ONT. 117 (Contd)																						
147.9	6/17/64	15	7.7				9.2															
	7/22/64	25	7.8				7.8															
	10/15/64	8	7.4	140	48	4	9.9	0.8							10							930
E 145	10/15/64	15	7.4	453	106	6	6.4	2.2	0.14	0.06	0.62	0.4		17	45							4,300
E 145	10/15/64	15	7.3	474	108	7	6.0	2.0							41							9,300
E 159	10/15/64	15	7.3	375	100	9	5.8	2.2							31							2,300
E 163	10/7/64	14	7.4	403	98	5	5.8	1.8	0.23	0.01	0.39	0.5	274	15	30	55	0.8					
	10/15/64																	0.01	0.53	0.06	0.15	4,300

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ANALYTICAL RESULTS - 1964-65
GENESEE RIVER BASIN
All values are in mg/l unless otherwise indicated

STREAM MILEAGE	DATE COLLECTED	TEMPERATURE °C	pH	CONDUCTIVITY u mhos/cm	ALKALINITY	TURBIDITY	DO	BOD-5 DAY	NITROGENS			TOTAL PHOSPHATES	SOLIDS		CHLORIDES	SULFATES	SILICON DIOXIDE	MANGANESE	IRON	ABS	FLUORIDES	COLIFORMS MPN
									NH_3	NO_3	ORGANIC		TOTAL	SUSPENDED								
BARGE CANAL																						
1 BC	6/16/64	21	7.6				5.0															
2 BC	6/16/64	21	7.6				4.8															
3 BC	6/16/64	21	7.7				4.8															
4 BC	6/16/64	21	7.7				8.0															
5 BC	6/16/64	21	7.9				8.6															
6 BC	6/16/64	21	7.8				8.2															
	6/17/65	19.0	7.9	410	108		7.7	4.4	0.34	0.25					47							
	7/14/65	24.0	8.0	480	111		7.1	2.8	0.19	0.36					48							
	9/23/65	2.3	7.9	480	107	2.9	5.3	2.8	0.18	0.20					52							
7 BC	6/16/64	21	7.8				8.0															
8 BC	6/16/64	21	7.8				8.4															

Table VI-2

ANALYTICAL RESULTS - 1964-65
GENESEE RIVER BASIN
All values are in mg/l unless otherwise indicated

STREAM MILEAGE	DATE COLLECTED	TEMPERATURE °C	pH	CONDUCTIVITY u mhos/cm	ALKALINITY	TURBIDITY	DO	BOD-5 DAY	NITROGENS			TOTAL PHOSPHATES	SOLIDS		CHLORIDES	SULFATES	SILICON DIOXIDE	MANGANESE	IRON	ABS	FLUORIDES	COLIFORMS MPN
									NH_3	NO_3	ORGANIC		TOTAL	SUSPENDED								
									RED	CREEK	ONT.	117-14										
0.01	6/24/64	25	8.1				7.4	5.2														
	6/29/64	26	8.4				11.4															4,300
0.05	6/16/64	21	8.1				6.8															
0.35	6/16/64	20	7.5				3.2															
	6/24/64	25	7.9				6.0	5.2														
	6/29/64	25	8.1				10.0															2,300
	8/5/64	23	7.7	640	119	8	5.6	4.1	0.39	0.34	0.91	0.8	525	41	54							930
1.20	6/24/64	24	7.5				4.2															
	6/29/64	24	7.8				7.8															2,300
2.10	6/24/64	24	8.0				10.4	3.6														
	8/5/64	19	7.4	1400	193	5	3.4	1.0	0.40	0.24	0.61	0.5	1284	6	49							9,300
3.50	6/24/64	23	6.1				3.8	11.1														
	6/29/64	25	7.3				2.8															43,000
	8/5/64	20	7.1	1310	182	15	0.6	24.0	2.00	3.00	0.58	7.0	1202	68	42							4,600,000
3.56	6/24/64	24	6.6				6.6	2.8														
	6/29/64	27	7.3				6.6															15,000
4.60	6/24/64	24	7.9				8.0	4.0														
6.60	6/24/64	23	8.2				10.2															

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ANALYTICAL RESULTS - 1964-65
GENESEE RIVER BASIN
All values are in mg/l unless otherwise indicated

STREAM MILEAGE	DATE COLLECTED	TEMPERATURE °C	pH	CONDUCTIVITY u mhos/cm	ALKALINITY	TURBIDITY	DO	BOD-5 DAY	NITROGENS			TOTAL PHOSPHATES	SOLIDS		CHLORIDES	SULFATES	SILICON DIOXIDE	MANGANESE	IRON	ABS	FLUORIDES	COLIFORMS MPN
									NH_3	NO_3	ORGANIC		TOTAL	SUSPENDED								
BLACK CREEK ONT. 117-19																						
0.00	7/2/64	26.0	8.3				10.0	3.6														
0.04	9/15/64	19.0	7.6	800	139	8	6.8	2.6	0.01	0.02	0.62	0.3	584	20	90	170	2.7					4,300 *
2.8	4/19/65	20	8.3	880	165			1.6							130							
	7/13/65	20.5	8.2	860	144		6.7	2.2	0.20	0.40					51							
	9/23/65	23.0	6.6	700	165	3.7	5.8	<1	0.03	0.48					27							
3.8	7/2/64	26.0	7.9				5.4	1.0														
	9/15/64	15.0	8.1	1640	134		8.6	0.6							50							2,300 *
6.85	7/2/64	25.0	8.0				5.6															
	9/14/64	14.0	7.9	1700	142	4	8.4	1.0	0.01	0.02	0.45	0.1	1875	11	52							7,500
8.55	7/2/64	25.0	7.7				3.2															
	9/14/64	15.0	7.9	1530	138	2	8.4	1.2	0.01	0.02	0.50	0.2	1609	4	52	810	3.1					2,300
10.15	7/2/64	25.0	7.6				2.91	0.9														
	9/14/64	14.0	7.8	1590	146	1	8.2	0.8	0.01	0.02	0.56	0.1	1612	6	51							4,300
11.2	7/1/64	28.0	7.7				4.8															
	9/14/64	15.0	7.9	1590	156	4	8.6	1.0							47							2,300
12.8	7/ 1/64	26.0	7.7				6.9															
	9/14/64	13.0	7.7	1550	167	3	8.4	1.2	0.01	0.02	0.56	0.1	1551	11	40							2,300
13.8	7/1/64	27.0	7.8				7.8															
	9/14/64	13.0	7.7	1520	126	3	8.0	1.6							43							750

* Sampled 9/14/64

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ANALYTICAL RESULTS - 1964-65
GENESEE RIVER BASIN
All values are in mg/l unless otherwise indicated

STREAM MILEAGE	DATE COLLECTED	TEMPERATURE °C	pH	CONDUCTIVITY u mhos/cm	ALKALINITY	TURBIDITY	DO	BOD-5 DAY	NITROGENS			TOTAL PHOSPHATES	SOLIDS		CHLORIDES	SULFATES	SILICON DIOXIDE	MANGANESE	IRON	ABS	FLUORIDES	COLIFORMS MPN
									NH_3	NO_3	ORGANIC		TOTAL	SUSPENDED								
BLACK CREEK ONT. 117-19 (Contd.)																						
15.95	7/1/64	27.0	8.1				8.2	1.2														
	9/14/64	17.0	8.1	1320	93	2	12.0	1.0	0.03		2.91	0.04	1208	2	52							430
18.1	7/1/64	25.5	7.9				6.2	4.5														
	9/14/64	18.0	7.5	1295	121	4	6.1	4.7	0.6	0.02	1.57	2.4	1202	8	51							1,000,000
19.20	7/1/64	26.0	8.1				8.8	1.3														
	9/14/64	19.0	7.7	1260	113	3	5.2	1.6	0.02	0.02	0.73	0.1	1196	9	48							2,300
22.4	7/1/64	24.5	7.7				2.91															
	9/14/64	15.0	7.8	1530	170	3	7.8	1.8	0.08	0.02	0.62	0.3	1552	5	50							4,300
25.9	7/1/64	25.0	7.8				4.4	1.0														
	9/14/64	14.0	7.9	1500	155	6	8.2	0.6	0.03	0.02	0.56	0.1	1569	12	35							2,300

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ANALYTICAL RESULTS - 1964-65
GENESEE RIVER BASIN
All values are in mg/l unless otherwise indicated

STREAM MILEAGE	DATE COLLECTED	TEMPERATURE °C	pH	CONDUCTIVITY u mhos/cm	ALKALINITY	TURBIDITY	DO	BOD-5 DAY	NITROGENS			TOTAL PHOSPHATES	SOLIDS		CHLORIDES	SULFATES	SILICON DIOXIDE	MANGANESE	IRON	ABS	FLUORIDES	COLIFORMS MPN
									NH_3	NO_3	ORGANIC		TOTAL	SUSPENDED								
									OATKA CREEK ONT. 117-25 (Contd)													
21.10	7/15/64	21.0	8.0				7.3	1.0														
	9/25/64	10.0	7.7	458	129	2	8.0	1.2							54							4,300
25.9	7/15/64	21.0	7.8				5.6	1.2														
	9/25/64	13.0	7.3	507	143	4	5.5	0.4							61							
28.8	7/15/64	21.0	7.8				5.8	1.3														
	9/25/64	14.0	7.4	548	155	3	4.4	0.8	0.06	0.04	0.5	0.2	362	4	59	39	1.1	0.02	0.24	0.07	0.15	
32.9	7/15/64	21.0	7.7				8.0	1.0														
	9/25/64	13.0	7.2	477	156	24	3.4	1.3	0.11	0.4	0.78	0.4	359	36	48							
36.6	7/15/64	21.0	7.7				7.0	1.0														
	9/25/64	13.0	7.3	520	163	7.0	3.6	1.3							59							
38.10	7/15/64	21.0	7.5				8.8	2.0														
44.1	7/15/64	20.0	7.6				6.0	2.6														
	9/24/64	17.0	7.5	563	.9.	6	6.4	6.6	5.6	0.06	1.12	12.0	370	12	52							2,300
45.8	7/15/64	20.0	7.6				5.2	3.6														
	9/24/64	15.0	7.3	685	224	12	0.2	25.8	15.0	0.02	3.08	12.0	426	46	70							1,500,000

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ANALYTICAL RESULTS - 1964-65
GENESEE RIVER BASIN
All values are in mg/l unless otherwise indicated

STREAM MILEAGE	DATE COLLECTED	TEMPERATURE °C	pH	CONDUCTIVITY u mhos/cm	ALKALINITY	TURBIDITY	DO	BOD-5 DAY	NITROGENS			TOTAL PHOSPHATES	SOLIDS		CHLORIDES	SULFATES	SILICON DIOXIDE	MANGANESE	IRON	ABS	FLUORIDES	COLIFORMS MPN
									NH_3	NO_3	ORGANIC		TOTAL	SUSPENDED								
									OATKA CREEK ONT. 117-25 (Cont'd)													
46.9	7/15/64	19.0	7.9				9.0	2.2														
	9/24/64	15.0	7.9	478	162	10	8.8	5.4							34							15,000
47.2	7/15/64	19.0	7.9				8.2	5.4														
	9/24/64	14.0	7.9	483	166	15	7.4	13.7	0.8	0.06	10.5	1.2	386	34	36							1,500
49.4	7/15/64	18.0	8.0				8.6	0.6														
	9/24/64	14.0	7.8	462	169	2	8.4	0.6	0.01	0.02	0.17	0.2	335	24	29	35	6.4	<0.01	0.32	<0.02	0.25	430

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ANALYTICAL RESULTS - 1964-65
GENESEE RIVER BASIN
All values are in mg/l unless otherwise indicated

STREAM MILEAGE	DATE COLLECTED	TEMPERATURE °C	pH	CONDUCTIVITY u mhos/cm	ALKALINITY	TURBIDITY	DO	BOD-5 DAY	NITROGENS			TOTAL PHOSPHATES	SOLIDS		CHLORIDES	SULFATES	SILICON DIOXIDE	MANGANESE	IRON	ABS	FLUORIDES	COLIFORMS MPN
									NH_3	NO_3	ORGANIC		TOTAL	SUSPENDED								
HONEOYE CREEK ONT. 117-27																						
0.1	7/14/64	21	7.8				5.8	1.5														
	8/25/64	19	7.9	1300	167	5	6.8	0.8	0.02	0.02	0.50	0.2	1360	4	28							2,300
	10/21/64	8	7.9	1430	204	1	9.2	1.8	0.01	0.04	0.34	0.8	1427	1	26	720	1.6	<0.01	0.11	0.06	0.34	230
1.4	7/13/64	20.0	8.6	710	153		7.3	3.3	0.14	0.35					30							
	9/27/64	13.0	8.4	1600	187	2.6	11.7	2.8							12							
4.1	7/14/64	21	8.0				6.2	0.8														
	8/25/64	18	7.7	1320	174	5	8.0	1.0							28							9,300
	10/21/64	6	7.9	1480	205	2	8.6	1.4							27							430
7.4	7/14/64	22	8.2				7.4	1.6														
	8/25/64	20	7.9	1130	171	5	9.0	1.0	0.03	0.02	0.62	1.0	1128	6	29							9,300
10.2	7/14/64	20	8.0				6.2	0.8														930
	8/25/64	20	7.7	1035	165	5	7.4	1.0							29							4,300
12.4	7/14/64	21	8.2				10.8	1.8														2,300
	8/25/64	20	8.1	525	159	5	10.2	1.6	1.4	0.06	0.84	5.04	396	3	33							7,500
	10/21/64	6	7.7	663	193	2	9.2	2.0							36							430
	4/16/64	5.0	8.2	280	84		12.0	3.6	0.10	1.15					19							
	4/19/64		8.3	420	120			1.6							31							
	7/14/64	22.5	7.9	500	172		6.2	2.6	0.05	0.22					27							

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ANALYTICAL RESULTS - 1964-65
GENESEE RIVER BASIN
All values are in mg/l unless otherwise indicated

STREAM MILEAGE	DATE COLLECTED	TEMPERATURE °C	pH	CONDUCTIVITY u mhos/cm	ALKALINITY	TURBIDITY	DO	BOD-5 DAY	NITROGENS			TOTAL PHOSPHATES	SOLIDS		CHLORIDES	SULFATES	SILICON DIOXIDE	MANGANESE	IRON	ABS	FLUORIDES	COLIFORMS MPN
									NH_3	NO_3	ORGANIC		TOTAL	SUSPENDED								
HONEOYE CREEK ONT. 117-27 (Contd)																						
13.5	7/14/64	23	7.9				8.6	3.0							28							46,000
	8/25/64	22	7.7	500	150	5	6.4	3.6														24,000
14.0	7/14/64	22	8.1				9.2	11.2														
	8/25/64	22	7.6	493	149	13	6.5	11.6							26							
16.3	7/14/64	22	8.3				9.2	0.6														9,300
	8/25/64	20	8.0	320	144	5	7.2	1.0	0.05	0.02	0.50	0.2	206	9	18							46,000
	10/21/64	6	8.0	347	166	1	9.0	2.2							15							750
20.6	7/14/64	22	8.3				10.0															
28.8	7/14/64	20	7.6				6.8															
33.7	7/14/64	21	7.9				7.2	1.0														
	8/26/64	19	8.0	370	154	5	9.4	1.0							9							930
	10/21/64	5	8.0	359	158	2	10.6	1.2	0.01	0.02	0.11	0.2	252	2				<0.01	0.10	<0.03	0.09	430

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ANALYTICAL RESULTS - 1964-65
GENESEE RIVER BASIN
All values are in mg/l unless otherwise indicated

STREAM MILEAGE	DATE COLLECTED	TEMPERATURE °C	pH	CONDUCTIVITY u mhos/cm	ALKALINITY	TURBIDITY	DO	BOD-5 DAY	NITROGENS			TOTAL PHOSPHATES	SOLIDS		CHLORIDES	SULFATES	SILICON DIOXIDE	MANGANESE	IRON	ABS	FLUORIDES	COLIFORMS MPN
									NH_3	NO_3	ORGANIC		TOTAL	SUSPENDED								
									TRIBUTARIES TO HONEOYE CREEK													
									HEMLOCK OUTLET ONT. 117-27-34-11													
5.3	7/14/64	20	7.5				4.0	1.7														
6.5	7/14/64	15	7.6				7.6	3.0														
	8/ /64	14	7.5	1120	176	5	6.4	2.8							270							
	10/21/64	10	7.7	1920	193	17	10.6	13.2							500							
									CANADICE OUTLET ONT. 117-27-34													
4.5	7/14/64	19																				
	8/26/64	19	7.8	97	31	12	8.4	0.8							5							
	10/21/64	10	7.6	96	34	2	10.4	2.0							4							

Table VI-2

ANALYTICAL RESULTS - 1964-65
GENESEE RIVER BASIN
All values are in mg/l unless otherwise indicated

STREAM MILEAGE	DATE COLLECTED	TEMPERATURE °C	pH	CONDUCTIVITY u mhos/cm	ALKALINITY	TURBIDITY	DO	BOD-5 DAY	NITROGENS			TOTAL PHOSPHATES	SOLIDS		CHLORIDES	SULFATES	SILICON DIOXIDE	MANGANESE	IRON	ABS	FLUORIDES	COLIFORMS MPN
									NH_3	NO_3	ORGANIC		TOTAL	SUSPENDED								
									CONESUS OUTLET ONT. 117-40													
1.9	6/25/64	21.0	8.1				8.8															
	8/13/64	17.0	8.4	300	107	20	9.0	0.8	0.09	0.02	0.73	0.2	260	43	22							4,300
	10/16/64	11.0	8.0	400	134	6.0	10.2	0.8	0.09	0.02	0.44	0.4	284	44	22	51	0.4	0.03	0.42	<0.03	0.16	3,900
4.0	6/25/64	24.0	8.9				9.2															
6.6	6/25/64	23.0					9.6															
	8/13/64	17.0	8.2	275	98	<5	9.8	0.8							19							930
8.5	6/25/64	22.0					5.9															
	8/13/64	19.0	7.1	285	94	<5	1.4	1.2	0.06	0.02	0.56	0.2	199	9	19							930
	10/16/64	10.0	7.3	320	123	7	6.4	1.8							19							1,500
9.8	6/25/64	23.0					8.8															
	8/13/64	19.0	7.7	285	93	<5	6.4	1.0							19							21,000
10.1	6/25/64	23.0					9.0															
	8/13/64	18.0	7.9	280	92	<5	6.4	2.6							18							4,300
10.2	6/25/64	23.0					9.4															
	8/13/64	19.0	8.1	270	92	<5	6.8	0.8	0.03	0.02	6.0	0.2	207	1	17							930
	10/16/64	11.0	8.1	295	104	2	8.8	1.2	0.03	0.02	0.50	0.1	192	6	19	27	0.4	0.01	0.12	0.03	0.14	930

Table VI-2

ANALYTICAL RESULTS - 1964-65
GENESEE RIVER BASIN
All values are in mg/l unless otherwise indicated

STREAM MILEAGE	DATE COLLECTED	TEMPERATURE °C	pH	CONDUCTIVITY u mhos/cm	ALKALINITY	TURBIDITY	DO	BOD-5 DAY	NITROGENS			TOTAL PHOSPHATES	SOLIDS		CHLORIDES	SULFATES	SILICON DIOXIDE	MANGANESE	IRON	ABS	FLUORIDES	COLIFORMS MPN
									NH_3	NO_3	ORGANIC		TOTAL	SUSPENDED								
									WILKINS CREEK ONT. 117-40-P67-2													
0.2	7/31/64	19.0	7.7				6.2	4.3														230,000
	9/1/64	18.0	7.6	930	185	<5	4.0		1.1	0.6	1.46	60.0	591	5	164							93,000
	9/16/64	14.0	7.6	955	179	6	8.0	2.8	4.0	4.0	1.40	30.0	614	6	170							4,300
0.6	7/31/64	18.0	7.4				3.4	6.8														150,000
	9/1/64	18.0	7.4	1120	204	5	2.0		0.				1236	3	230							75,000
	9/16/64	12.0	7.4	1145	177	12	4.8	6.2							240							39,000
1.0	7/13/64	18.0	7.9				8.0	0.4														46,000
	9/1/64	18.0	8.2	1680	259	<5	7.8		0.03	0.02	0.39	0.2	1119	2	425							2,300
	9/16/64	12.0	7.9	1920	265	3	9.4	1.4	0.4	0.02	0.39	0.2			520							1,500
									S. McWILLIAM CREEK ONT. 117-40-P67-10-2													
6.4	7/31/64	17.0	7.0				1.2	9.0														
	9/1/64	19.0	8.6	530	218	175	1.4								28							240,000
	9/9/64	20.0	8.8	455	223	450	2.4	5.04							27							240,000

Table VI-2

ANALYTICAL RESULTS - 1964-65
GENESEE RIVER BASIN
All values are in mg/l unless otherwise indicated

STREAM MILEAGE	DATE COLLECTED	TEMPERATURE °C	pH	CONDUCTIVITY u mhos/cm	ALKALINITY	TURBIDITY	DO	BOD-5 DAY	NITROGENS			TOTAL PHOSPHATES	SOLIDS		CHLORIDES	SULFATES	SILICON DIOXIDE	MANGANESE	IRON	ABS	FLUORIDES	COLIFORMS MPN
									NH_3	NO_3	ORGANIC		TOTAL	SUSPENDED								
								CANASERAGA CREEK ONT. 177-66														
1.1	7/8/64	21	7.8				5.8	2.7														
	8/19/64	13	7.9	390	153	55	6.8	4.0	0.60	0.06	0.90	0.8	313	50	21							
	10/19/64	12	7.7	450	176	9	5.4	5.8	0.35	0.04	0.73	0.8	351	37	23	38	1.7					
	4/16/65	5.0	8.1	300	80		13.0	3.3	0.20	4.85					17							
	7/14/65	5.2	8.1	355	160		5.2	4.3	0.35	0.21					25							
	9/30/65	13.0	7.8	480	174		7.5	3.9	0.38	0.16					40							
9.9	7/8/64	21	8.2				6.2	2.6														24,000
10.9	7/8/64	21	8.1				6.0	2.6														46,000
	8/19/64	19	8.1	365	147	15	7.6	3.0							18							240,000
	10/19/64	12	8.0	400	167	4	7.4	3.4							13							9,800
14.2	7/8/64	19	7.9				6.8	2.5														
	8/19/64	18	7.9	360	153	25	8.6	3.8	0.12	0.06	2.02	0.4	293	47	16							240,000
	10/19/64	12	7.9	420	167	5	8.0	3.0							14							230,000
16.4	7/8/64	21	8.3				9.8	4.2														24,000
18.2	7/8/64	22	8.5				10.8	5.2														29,000
	8/19/64	18	8.2	360	148	7	10.2	4.0	0.80	0.06	1.29	0.8	250	19	17							230,000
	10/19/64	11	8.1	395	161	6	10.0	4.0							12							

Table VI-2

ANALYTICAL RESULTS - 1964-65
GENESEE RIVER BASIN
All values are in mg/l unless otherwise indicated

STREAM MILEAGE	DATE COLLECTED	TEMPERATURE °C	pH	CONDUCTIVITY u mhos/cm	ALKALINITY	TURBIDITY	DO	BOD-5 DAY	NITROGENS			TOTAL PHOSPHATES	SOLIDS		CHLORIDES	SULFATES	SILICON DIOXIDE	MANGANESE	IRON	ABS	FLUORIDES	COLIFORMS MPN
									NH_3	NO_3	ORGANIC		TOTAL	SUSPENDED								
								CANASAREGA CREEK ONT. 117-66 (Contd)														
19.3	7/8/64	19	8.3				10.6	3.0														
	8/19/64	17	8.3	350	144	12	10.4	0.8	0.02	0.06	2.13	0.2	257	28	15							9,300
	10/19/64	11	8.1	375	159	4	10.2	1.4							11							
23.5	7/8/64	18	8.2				9.4	1.0														930
	8/19/64	16	8.3	355	1155	5	9.6	0.2							10							430
	10/19/64	10	8.2	370	161	2	10.4	0.6	0.05	0.12	0.28	0.4	216	9	16	30	5.2	<0.01	0.12	<0.03	0.12	430

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ANALYTICAL RESULTS - 1964-65
GENESEE RIVER BASIN
All values are in mg/l unless otherwise indicated

STREAM MILEAGE	DATE COLLECTED	TEMPERATURE °C	pH	CONDUCTIVITY u mhos/cm	ALKALINITY	TURBIDITY	DO	BOD-5 DAY	NITROGENS			TOTAL PHOSPHATES	SOLIDS		CHLORIDES	SULFATES	SILICON DIOXIDE	MANGANESE	IRON	ABS	FLUORIDES	COLIFORMS MPN
									NH_3	NO_3	ORGANIC		TOTAL	SUSPENDED								
								KESHEQUA CREEK CNT. 117-66-3														
1.3	6/26/64	18.0	7.9				8.6															
	8/6/64	16.0	7.5	740	180	<5	6.8	7.4	0.12	2.5	0.16	1.8	569	11	102							75,000
	10/26/64	14.0	8.6	600	175	3	17.0	1.0	0.01	0.24	0.28	0.9	378	4	58	66	3.2	<0.01	0.10	<0.03	0.30	4,300
2.4	6/26/64	19.0	7.9				8.6															
	8/6/64	17.0	7.7	420	156	<5	8.0	0.4							18							1,500
7.6	6/26/64	20.0	8.1				8.8															
10.4	6/26/64	19.0	8.0				8.8															
	8/6/64	21.0	8.2	410	162	<5	8.8	0.6	0.06	0.02	0.16	<0.2	346	6	18							930
13.0	6/26/64	19.0	8.6				11.4															
	8/6/64	19.0	8.5	410	156	<5	11.2	1.2							21							2,300
	10/26/64	11.0	8.6	450	172	3	13.4	1.8							17							15,000
13.6	6/26/64	20.0	8.2				8.8															
	8/6/64	18.0	8.0	440	159	5	7.8	12.9	0.08	0.04	0.87	3.3	347	20	21							150,000
15.2	6/26/64	19.0	8.4				9.2															
	8/6/64	15.9	8.3	410	165	<5	9.8	0.6	0.02	0.2	0.2	<0.2	300	4	15							430
	10/26/64	11.0	8.3	450	172	1	11.2	0.6	0.01	0.08	0.17	0.1	326	4	15	53	6.2	<0.01	0.09	<0.03	0.05	430
16.5	6/26/64	17.0	8.3				9.6															

Table VI-2

ANALYTICAL RESULTS - 1964-65
GENESEE RIVER BASIN
All values are in mg/l unless otherwise indicated

STREAM MILEAGE	DATE COLLECTED	TEMPERATURE °C	pH	CONDUCTIVITY u mhos/cm	ALKALINITY	TURBIDITY	DO	BOD-5 DAY	NITROGENS			TOTAL PHOSPHATES	SOLIDS		CHLORIDES	SULFATES	SILICON DIOXIDE	MANGANESE	IRON	ABS	FLUORIDES	COLIFORMS MPN
									NH_3	NO_3	ORGANIC		TOTAL	SUSPENDED								
								MILL CREEK ONT. 117-66-22														
0.5	7/13/64	18.0	8.6				9.2	2.6														24,000
	8/17/64	15.0	8.6	360	137	12	10.2	2.0	**0.01**	0.18	0.95	0.3	303	30	21							**2,300**
	10/26/64	9.0	8.3	380	154	7	12.0	1.4	0.01	0.12	0.22	0.2	271	10	12	31	7.2	<0.01	0.23	<0.03	<0.05	2,300
2.7	7/13/64	18.0	8.4				8.6	3.6														46,000
	8/17/64	15.0	8.6	355	131	25	10.0	2.6							19							
5.2	7/13/64	17.0	8.0				8.6	7.4														110,000
	8/17/64	15.0	8.0	355	123	12	99.4	4.2	0.6	0.4	1.2	0.4	304	28	22							46,000
5.6	7/13/64	17.0	7.7				7.0	6.8														110,000
	8/17/64	15.0	8.2	340	121	12	9.0	3.4							20							43,000
6.1	7/13/64	16.0	8.0				8.2	1.0														
	8/17/64	15.0	8.2	295	125	<5	9.8	0.8							8							15,000
7.4	7/13/64	16.0	8.1				9.2	1.2														3,900
	8/17/64	17.0	8.3	280	122	5	10.0	0.4	0.01	0.4	0.45	0.2	213	5	8							750
	10/26/64	9.0	8.1	310	129	4	11.0	2.8	0.01	0.3	0.22	0.1	211	8	8	**23.**	7.8	<0.01	0.16	< 0.03	0.07	430

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ANALYTICAL RESULTS - 1964-65
GENESEE RIVER BASIN
All values are in mg/l unless otherwise indicated

STREAM MILEAGE	DATE COLLECTED	TEMPERATURE °C	pH	CONDUCTIVITY u mhos/cm	ALKALINITY	TURBIDITY	DO	BOD-5 DAY	NITROGENS			TOTAL PHOSPHATES	SOLIDS		CHLORIDES	SULFATES	SILICON DIOXIDE	MANGANESE	IRON	ABS	FLUORIDES	COLIFORMS MPN
									NH_3	NO_3	ORGANIC		TOTAL	SUSPENDED								
								SILVER LAKE OUTLET ONT. 117-70														
1.25	7/20/64	24	8.1				8.0	1.0														9,300
	8/24/64	18.0	8.1	435	127	<5	9.2	1.0	0.07	2.0	0.90	0.4	346	3	40							
	10/20/64	7.0	7.8	640	176	2	11.0	7.8	1.10	1.5	0.90	11.0	395	1	70			<0.01	0.20	1.50	1.40	
3.1	7/20/64	23	7.5				5.4	6.2														110,000
	8/24/64	17.0	7.4	390	123	<5	6.6	8.4							33							
	10/20/64	7.0	7.7	300	120	5	8.0	3.6	0.06	0.02	0.95	0.2	226	3	13	25	0.9					
5.4	7/20/64	24.0	7.9				7.0	1.6														4,300
	8/24/64	18.0	7.8	270	88	<5	8.0	0.6							17							
6.7	7/20/64	26.0	7.5				4.4	2.5														2,300
	8/24/64	19.0	7.7	230	81	<5	6.2	2.0	0.06	0.02	0.73	0.1	202	4	10							
	10/20/64	6.0	7.7			5	4.4	2.5										<0.01	0.39	<0.03	0.09	

Table VI-2

ANALYTICAL RESULTS - 1964-65
GENESEE RIVER BASIN
All values are in mg/l unless otherwise indicated

STREAM MILEAGE	DATE COLLECTED	TEMPERATURE °C	pH	CONDUCTIVITY u mhos/cm	ALKALINITY	TURBIDITY	DO	BOD-5 DAY	NITROGENS			TOTAL PHOSPHATES	SOLIDS		CHLORIDES	SULFATES	SILICON DIOXIDE	MANGANESE	IRON	ABS	FLUORIDES	COLIFORMS MPN
									NH_3	NO_3	ORGANIC		TOTAL	SUSPENDED								
									WOLF	CREEK	ONT.	117-87										
0.25	7/16/64	20	8.6				9.6	1.9							3020							
	8/21/64	22	8.6	9800	127	8	9.2	0.8	0.03	0.40	0.62	0.2	6520	10	3550							430
		6	8.3	15760	131	3	11.8	2.0	0.01	1.60	0.17	0.1	13220	8	6320	450	0.04	<0.01	0.16	0.04	0.05	430
2.6	7/16/64	20	8.2				9.6	1.9							3020							
	8/31/64	22	8.7	15500	112	5	12.2	4.0							6049							1,500,000
4.4	7/16/64	20	8.2				10.0	3.0							2840							
	8/31/64	19	8.3	10800	128	7	12.2	3.0							4080							43,000
5.7	7/16/64	16	7.8				7.8	1.4							227							
	8/13/64	19	7.8	1160	189	7	7.0	1.2	0.1	1.40	0.45	0.1	745	14	256							24,000

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ANALYTICAL RESULTS - 1964-65
GENESEE RIVER BASIN
All values are in mg/l unless otherwise indicated

STREAM MILEAGE	DATE COLLECTED	TEMPERATURE °C	pH	CONDUCTIVITY u mhos/cm	ALKALINITY	TURBIDITY	DO	BOD-5 DAY	NITROGENS			TOTAL PHOSPHATES	SOLIDS		CHLORIDES	SULFATES	SILICON DIOXIDE	MANGANESE	IRON	ABS	FLUORIDES	COLIFORMS MPN
									NH_3	NO_3	ORGANIC		TOTAL	SUSPENDED								

Table VI-2

ANALYTICAL RESULTS - 1964-65
GENESEE RIVER BASIN
All values are in mg/l unless otherwise indicated

STREAM MILEAGE	DATE COLLECTED	TEMPERATURE °C	pH	CONDUCTIVITY u mhos/cm	ALKALINITY	TURBIDITY	DO	BOD-5 DAY	NITROGENS			TOTAL PHOSPHATES	SOLIDS		CHLORIDES	SULFATES	SILICON DIOXIDE	MANGANESE	IRON	ABS	FLUORIDES	COLIFORMS MPN
									NH_3	NO_3	ORGANIC		TOTAL	SUSPENDED								
EAST ROY CREEK ONT. 117-104+3																						
0.8	8/3/64	20.0	7.9				8.0	0.4														
	9/8/64	20.0	8.4	330	123	<5	9.6	0.4	0.02	0.24	2.5	0.3	218	4	14							930
	10/23/64	6.0	8.1	360	144	1	12.0	0.8	0.01	0.50	0.34	0.1	232	4	12	35		<0.01	0.09	<0.03	0.09	750
2.4	8/3/64	19.0	8.8				8.8	1.0														
6.5	8/3/64	19.0	7.9				8.6	0.5														
	9/8/64	18.0	8.1	350	135	<5	9.6	0.6							13							
9.8	8/3/64	19.0	8.1				8.2	0.8														
15.0	8/3/64	18.0	7.9				8.2	0.6														
		18.0	8.0	315	132	<5	9.2	0.8	0.02	0.60	0.34	0.2	224	7	11							

Table VI-2

ANALYTICAL RESULTS - 1964-65
GENESEE RIVER BASIN
All values are in mg/l unless otherwise indicated

STREAM MILEAGE	DATE COLLECTED	TEMPERATURE °C	pH	CONDUCTIVITY u mhos/cm	ALKALINITY	TURBIDITY	DO	BOD-5 DAY	NITROGENS			TOTAL PHOSPHATES	SOLIDS		CHLORIDES	SULFATES	SILICON DIOXIDE	MANGANESE	IRON	ABS	FLUORIDES	COLIFORMS MPN
									NH_3	NO_3	ORGANIC		TOTAL	SUSPENDED								
									CANADEA CREEK ONT. 117-136													
0.25	7/29/64	24.0	8.2				8.6	1.0														2,300
	9/10/64	15.0	7.7	123	49	<5	9.2	0.6							4							2,300
	10/27/64	11.0	7.7	128	48		10.8	0.8	0.01	0.36	0.56	0.1	325		3	16	32	0.5	12.9	<0.03	<0.05	4,300

Table VI-2

ANALYTICAL RESULTS - 1964-65
GENESEE RIVER BASIN
All values are in mg/l unless otherwise indicated

STREAM MILEAGE	DATE COLLECTED	TEMPERATURE °C	pH	CONDUCTIVITY u mhos/cm	ALKALINITY	TURBIDITY	DO	BOD-5 DAY	NITROGENS			TOTAL PHOSPHATES	SOLIDS		CHLORIDES	SULFATES	SILICON DIOXIDE	MANGANESE	IRON	ABS	FLUORIDES	COLIFORMS MPN
									NH_3	NO_3	ORGANIC		TOTAL	SUSPENDED								
ANGELICA CREEK ONT. 117-155																						
0.5	7/30/64	23.0	7.8				7.8	0.2														930
	9/10/64	20.0	7.5	270	110	<5	7.0	0.2							10							430
	10/27/64	12.0	7.7	270	112	1	10.2	0.2	0.01	0.02	0.11	0.2	182	3	9			<0.01	0.10	<0.03	0.09	230

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ANALYTICAL RESULTS - 1964-65
GENESEE RIVER BASIN
All values are in mg/l unless otherwise indicated

STREAM MILEAGE	DATE COLLECTED	TEMPERATURE °C	pH	CONDUCTIVITY u mhos/cm	ALKALINITY	TURBIDITY	DO	BOD-5 DAY	NITROGENS			TOTAL PHOSPHATES	SOLIDS		CHLORIDES	SULFATES	SILICON DIOXIDE	MANGANESE	IRON	ABS	FLUORIDES	COLIFORMS MPN
									NH_3	NO_3	ORGANIC		TOTAL	SUSPENDED								
									VAN CAMPEN CR. ONT. 117-164													
0.5	7/29/64	26.0	8.7				9.0	0.6														
	9/10/64	24.0	8.3	250	88	<5	10.0	0.2	0.01	0.06	0.11	0.1	196	7	25							2,300
	10/27/64	11.0	8.1	300	107	2	12.0	0.6	0.01	0.02	0.11	0.1	175	3	31	12	3.0	0.01	0.13	<0.03	0.12	230
2.5	7/29/64	24.0	7.1				5.8	2.4														
4.0	7/29/64	25.0	7.4				6.0	1.6														
	9/10/64	23.0	7.3	325	134	12	4.8	2.0							28							46,000
4.6	7/29/64	24.0	7.1				4.8	<21														
	9/10/64	22.0	7.1	310	113	10	6.0	3.0							27							43,000
4.7	7/29/64	23.0	7.3				6.2	<21														
5.7	7/29/64	22.0	7.7				7.2	0.6														
	9/10/64	19.0	7.5	300	99	<5	7.6	0.6	0.02	0.04	0.50	0.1	219	3	34							2,300

Table VI-2

ANALYTICAL RESULTS - 1964-65
GENESEE RIVER BASIN
All values are in mg/l unless otherwise indicated

STREAM MILEAGE	DATE COLLECTED	TEMPERATURE °C	pH	CONDUCTIVITY u mhos/cm	ALKALINITY	TURBIDITY	DO	BOD-5 DAY	NITROGENS			TOTAL PHOSPHATES	SOLIDS		CHLORIDES	SULFATES	SILICON DIOXIDE	MANGANESE	IRON	ABS	FLUORIDES	COLIFORMS MPN
									NH_3	NO_3	ORGANIC		TOTAL	SUSPENDED								
									KNIGHT CREEK ONT.			117-175										
0.2	7/30/64	23.0	8.4			<5	9.8	2.4														750
	9/10/64	24.0	8.8	1060	78		11.0	0.8							320							3,900
	10/27/64	12.0	8.2	1550	95	1	12.4	0.2	0.01	0.02	0.22	0.1	1003	14	400			<0.01	0.10	<0.03	0.09	230

Table VI-2

ANALYTICAL RESULTS - 1964-65
GENESEE RIVER BASIN
All values are in mg/l unless otherwise indicated

STREAM MILEAGE	DATE COLLECTED	TEMPERATURE °C	pH	CONDUCTIVITY u mhos/cm	ALKALINITY	TURBIDITY	DO	BOD-5 DAY	NITROGENS			TOTAL PHOSPHATES	SOLIDS		CHLORIDES	SULFATES	SILICON DIOXIDE	MANGANESE	IRON	ABS	FLUORIDES	COLIFORMS MPN
									NH_3	NO_3	ORGANIC		TOTAL	SUSPENDED								
									DYKE CREEK ONT. 117-184													
0.3	7/30/64	21.0	8.2	210			3.2	0.8														
	9/22/64	18.0	7.7	230	79	2	10.2	0.8	0.02	0.04	0.39	0.1	117	11	15			<0.01	0.37	<0.03	0.14	1,500
	10/23/64	10.0	7.9	205	77	3	10.4	0.6	0.01	0.06	0.22	0.1	136	7	19	1.9						930
6.0	7/30/64	21.0	8.2	210			3.2	0.8														
	9/22/64	17.0	7.5	206	56	5	8.2	1.2							19							7,500
8.0	7/30/64	18.0	6.8	170			9.0	0.4							22							
	9/22/64	16.0	6.9	189	38	4	9.2	0.6														930
10.4	7/30/64	20.0	8.4	450			10.8	0.8														
	9/22/64	19.0	8.9	745	64	<1	12.0	0.8	0.02	0.02	1.51	0.1	155	8	160							150

Table VI-2

ANALYTICAL RESULTS - 1964-65
GENESEE RIVER BASIN
All values are in mg/l unless otherwise indicated

STREAM MILEAGE	DATE COLLECTED	TEMPERATURE °C	pH	CONDUCTIVITY u mhos/cm	ALKALINITY	TURBIDITY	DO	BOD-5 DAY	NITROGENS			TOTAL PHOSPHATES	SOLIDS		CHLORIDES	SULFATES	SILICON DIOXIDE	MANGANESE	IRON	ABS	FLUORIDES	COLIFORMS MPN
									NH_3	NO_3	ORGANIC		TOTAL	SUSPENDED								
									CRYDER CREEK ONT. 117-201													
1.6	7/30/64	23.0	7.5	132			6.8	2.4														
	9/22/64	16.0	7.3	175	56	6	8.0	2.6	0.03	0.02	2.07	0.3	150	15	15							390
	10/27/64	7.0	7.5	144	54	7	10.8	1.2	0.03	0.06	0.22	0.1	180	7	13	14	2.0	0.02	0.43	<0.03	0.05	230
4.8	7/30/64	18.0	7.5	128			8.6	0.6														
	9/22/64	18.0	7.2	161	46	3	8.2	1.0							16							2,300
6.0	7/30/64	19.0	7.2	133			10.0	5.2														
	9/22/64	14.0	7.5	186	53	6	10.0	5.8							22							9,300
6.3	7/30/64	19.0	7.3	123			8.2	2.6														
	9/22/64	14.0	7.4	178	52	4	8.2	1.0	0.01	0.06	0.50	0.1	124	11	21							930

LABORATORY RESULTS OF LAKE SAMPLING

Table VI-3

CONESUS LAKE CNTY. 117-40-P67

Date	Sampling Station	Turb	Temp° C	pH	CO_2 *	D.O. mg/l	D.O. %Sat.	BOD	Total Hard *	Cl	Alkalinity Total *	Alkalinity Carb. *	MPN	Plate Count Per ml	Cond.	Total Solids	NH_3 Free **	NH_3 Organic **	NO_2 **	NO_3 **	PO_4
8/10/65	#1 North End-Cluny Point																				
	West	∠1	23	8.5	0	8.0	92.2	0.4	136	22	102	8	5	47	250	122	0.01	0.34	0.002	0.02	0.2
	East	∠1	23	8.3	0	8.0	92.2	0.8	148	22	101	12	5	23	240	111	0.01	0.34	0.002	0.02	0.1
	#2 Middle-North																				
	West-Eagle Pt.	∠1	23	8.3	0	8.0	92.2	0.8	164	22	102	10	∠2.2	38	240	133	0.01	0.28	0.002	0.02	0.1
	East-Old Orchard Pt.	∠1	23	8.3	0	8.0	92.2	0.2	148	22	114	8	20	62	240	196	0.01	0.28	0.002	0.02	0.1
	#3 Middle-South																				
	West-Long Pt.	∠1	23	8.3	0	8.2	94.5	0.6	144	21	103	8	8.8	71	240	197	0.01	0.34	0.002	0.02	0.2
	East-McPherson Pt.	∠1	23	8.3	0	8.0	92.2	0.4	136	22	102	10	2.2	45	250	204	0.01	0.34	0.002	0.02	0.1
	#4 South End-Cotton-wood Pt.																				
	West	∠1	22	8.3	0	8.0	90.6	0.4	140	23	102	10	5	9	260	124	0.03	0.39	0.002	0.02	0.2
	East	∠1	22	8.2	0	8.0	90.6	0.6	140	20	109	10	5	75	250	190	0.01	0.67	0.002	0.02	0.4

Note:
Results in mg/l unless indicated otherwise

* mg/l as $CaCo_3$

** mg/l as N

LABORATORY RESULTS OF LAKE SAMPLING
Table VI-3 (Cont)
HONEOYE LAKE ONT 117-27-P57

Date	Sampling Station	Turb	Temp°	pH	CO_2	D.O. mg/l	D.O. %Sat.	BOD	Total Hard	Cl	Alkalinity Total	Alkalinity Carb.	MPN	Plate Count	Cond.	Total Solids	NH_3 Free	NH_3 Organic	NO_2	NO_3	PO_4
	#1 North End		C°		*				*		*	*		Per ml			**	**	**	**	
	West Side	7	22	8.8	0	8.0	90.6	2.0	78	3	62	8	5	18	130	149	0.01	<0.06	0.002	0.02	0.1
	East Side	4	22	8.5	0	7.6	86.1	2.2	76	2	65	8	5	19	120	167	0.01	<0.06	0.002	0.02	0.1
8/12/65																					
	#2 Middle																				
	West Side	4	22	8.6	0	8.2	92.9	2.2	76	2	66	8	5	58	120	165	0.02	0.34	0.002	0.02	0.1
	East Side	7	22	8.7	0	8.4	95.1	2.6	80	1	62	8	8.8	26	120	173	0.01	0.39	0.002	0.02	0.1
	#3 South End																				
	West Side	5	23	8.7	0	8.8	101	2.8	80	3	63	10	5	16	110	134	0.02	0.45	0.002	0.02	0.1
	East Side	4	23	8.7	0	8.6	99.1	2.2	70	2	65	8	42.2	38	110	116	0.01	0.45	0.002	0.02	0.1

LABORATORY RESULTS OF LAKE SAMPLING

Table VI-3 (Cont)

SILVER LAKE ONT 117-70-P115

Date	Sampling Station	Turb	Temp°	pH	CO_2	D.O. mg/l	D.O. %Sat.	BOD	Total Hard	Cl	Alkalinity Total	Alkalinity Carb	MPN	Plate Count	Cond.	Total Solids	NH_3 Free	NH_3 Organic	NO_2	NO_3	PO_4
	#1 North End		C°		*				*		*	*		Per ml			**	**	**	**	
	West Side	<1	22	8.2	0	7.8	88.3	1.2	124	13	86	4	8.8	13	240	223	0.01	0.56	0.002	0.02	0.2
	East Side	<1	22	8.2	0	7.8	88.3	0.8	128	14	87	4	<2.2	4	210	233	0.01	0.50	0.002	0.02	0.4
	#2 Middle																				
8/11/65	West Side	<1	22	8.3	0	8.0	90.6	1.2	120	13	84	6	<2.2	8	190	204	0.03	0.56	0.002	0.02	0.1
	East Side	<1	23	8.2	0	8.0	92.2	1.0	124	11	86	6	2.2	19	180	229	0.03	0.56	0.002	0.02	0.1
	#3 South End																				
	West Side	<1	22	8.2	0	8.2	92.9	1.2	120	13	86	6	21	68	150	200	0.01	0.50	0.002	0.02	0.1
	East Side	<1	22	8.2	0	8.0	90.6	1.0	124	14	85	6	5	82	165	198	0.01	0.45	0.002	0.02	0.1

Drainage Basin 4
Station Number 5
Stream Mileage 4.30

Table VI-4

Stream Name Genesee River
Stream Number Ont. 117

All values are in mg/l unless otherwise indicated

DATE COLLECTED	TEMPERATURE °C	pH	CONDUCTIVITY u mhos/cm	TOTAL ALK. as $CaCO_3$	TURBIDITY	DISSOLVED OXYGEN	BOD-5 DAY	NITROGEN as N			TOTAL PHOSPHATES as PO_4	SOLIDS		CHLORIDES as Cl	SULFATES as SO_4	SILICA DIOXIDE as SiO_2	MANGANESE as Mn	IRON as Fe	ABS	COLOR	CARBON DIOXIDE as CO_2	CALCIUM as $CaCO_3$	SODIUM as Na	POTASSIUM as K	TOTAL HARDNESS as $CaCO_3$
								AMMONIA	NITRITE	NITRATE		TOTAL	SUSPENDED												
12/11/63		7.5	435	92	10			0.134	.008	.48	0.24	377		49	88	3.7	.04	1.00	.08	10		156	32.0	3.3	200
7/13/64		7.2	360	98	20			0.380	.160	.04	0.10	310		42	53	1.1	.09	0.50	.08	8		136	28.0	1.5	172
10/19/64		7.3	500	95	17			0.312	.030	.08	0.30	379		45	90	0.9	.30	0.80	.04	7		148	32.2	9.8	184
10/4/65		7.4	458	104				0.460	.055	.14	0.45	216	34	46	33		.11	0.58	<.01			142	50.0	2.5	185
11/12/65		7.5	389	102				0	.036	.51	0.40	504	22	56	115		.09	0.18	<.01			187	68.0	3.4	240
4/18/66		7.0	411	108	25	7.2	4.4	0.728	.007	.47	0.13	262	18	27	43		.09	0.24	<.01	20		204	27.0	2.7	218
5/23/66	17	7.0	448	98	30	8.8	6.1	0.800	.013	.38	0.10	315	51	25	72		.10	0.29	.01	25		122	34.0	2.2	186
6/27/66		7.6	372	100				0.670	.015	.31	0.35	276	10	35	69		.08	0.24	.01			136	29.0	2.5	182

Table VI-4 (cont'd.)

Drainage Basin 4
Station Number 20
Stream Mileage 14.6

Stream Name Genesee River
Stream Number Ont. 117

All values are in mg/l unless otherwise indicated

DATE COLLECTED	TEMPERATURE °C	pH	CONDUCTIVITY u mhos/cm	TOTAL ALK. as $CaCO_3$	TURBIDITY	DISSOLVED OXYGEN	BOD-5 DAY	NITROGEN as N: AMMONIA	NITROGEN as N: NITRITE	NITROGEN as N: NITRATE	TOTAL PHOSPHATES as PO_4	SOLIDS: TOTAL	SOLIDS: SUSPENDED	CHLORIDES as Cl	SULFATES as SO_4	SILICA as SiO_2	MANGANESE as Mn	IRON as Fe	ABS	COLOR	CARBON DIOXIDE as CO_2	CALCIUM as $CaCO_3$	SODIUM as Na	POTASSIUM as K	TOTAL HARDNESS as $CaCO_3$
12/11/63		7.8	375	84	23			.050	.005	.30	.19	313		54	66	3.8	.05	1.0	.03	5		124	35	3.0	164
6/16/63	21	8.1				4.6																			
7/13/64		7.5	525	147	17			.076	.003	.04	.12	422		71	92	3.1	.10	.8	<.03	10		190	45	2.7	230
10/14/64	10	7.6	390	135	6	5.6	2.2							120						10					335
10/19/64		7.6	790	134	7			.088	.012	.16	.20	638		114	195	3.0	.20	.38	.03	8		260	69	13.0	340
10/4/65		7.6	890	118							.75	557	18	106	140		.07	.61	<.01		6	235	149	3.7	318
11/10/65		7.7	485	115				0	.007	.42	1.60	402	5	68	109		.07	.29	.01			167	106	3.4	226
11/29/65	3	7.0	275	62	45	11.8	1.2	0	.023	.58	.66	223	182	35	32		.15	.24	0			76	33	2.4	113
12/13/65	3	7.7	439	87	27	12.4	1.6	.016	.012	.45	.95	804	38	58	75		.07	.43	<.01			123	34	2.6	168
1/3/66	4	7.4	315	74	21	11.8		.030	.019	.10	.35	342	89	35	93		.07	.10	<.01			108	101	2.4	146
3/14/66	4	7.7	287	70	110	12.0	3.3	.382	.020	1.12	.65	437	370	28	49		.28	.30	<.01			100	42	2.1	128
4/11/66		7.8	310	76				.308	.008	.77	.40	117	32	26	54		.02	.28	.01			108	31	1.6	144
5/23/66		6.9	360	108	25	6.0	2.0	.400	.008	.56	.15	310	59	22	55		.07	.23	.01	15		119	26	2.5	159
6/27/66		7.7	365	100				.610	.012	.21	.22	223	31	33	62		.01	.46	<.01			132	23	2.3	182

Drainage Basin 4
Station Number 50
Stream Mileage 1.9

Table VI-4 (cont'd.)

All values are in mg/l unless otherwise indicated

Stream Name Honeoye Creek
Stream Number Ont. 117-27

DATE COLLECTED	TEMPERATURE °C	pH	CONDUCTIVITY u mhos/cm	TOTAL ALK. as $CaCO_3$	TURBIDITY	DISSOLVED OXYGEN	BOD-5 DAY	NITROGEN as N: AMMONIA	NITRITE	NITRATE	TOTAL PHOSPHATES as PO_4	SOLIDS: TOTAL	SUSPENDED	CHLORIDES as Cl	SULFATES as SO_4	SILICA DIOXIDE as SiO_2	MANGANESE as Mn	IRON as Fe	ABS	COLOR	CARBON DIOXIDE as CO_2	CALCIUM as $CaCO_3$	SODIUM as Na	POTASSIUM as K	TOTAL HARDNESS as $CaCO_3$
11/29/65	2	7.6	96	211	5	13.3	1.5	.100	.015	.46	1.20	822	22	81	251		.02	.07	0			369	18	4.0	542
12/13/65	4	7.9	890	184	5	11.2		.182	.024	.76	1.40	788	6	44	391		.08	.06	.01			379	31	3.7	544
1/3/66	4	7.4	438	128	27	11.4	2.9	.260	.026	2.17	.25	437	54	28	105		.06	.40	.01			148	41	3.6	256
3/14/66	3	7.8	370	123	20	12.2	1.3	.480	.017	1.08	.45	265	39	17	66		.04	.15	.01			162	13	2.3	194
4/11/66		8.2	394	125				.150	.006	.50	.28	283	19	16											224
5/23/66	18	8.0	451	132	20	7.2	3.4	.520	.006	.17	.33	400	15	14	72		.05	.21	.01	40		191	16	2.0	242
6/27/66		7.9	590	134				.784	.006	.12	1.01	487	11	17	79		.01	.11	.01			269	12	1.4	364

Drainage Basin 4
Station Number 65
Stream Mileage 60.7

Table VI-4 (cont'd.)

All values are in mg/l unless otherwise indicated

Stream Name Genesee River
Stream Number Ont. 117

DATE COLLECTED	TEMPERATURE °C	pH	CONDUCTIVITY u mhos/cm	TOTAL ALK. as $CaCO_3$	TURBIDITY	DISSOLVED OXYGEN	BOD-5 DAY	NITROGEN as N: AMMONIA	NITROGEN as N: NITRITE	NITROGEN as N: NITRATE	TOTAL PHOSPHATES as PO_4	SOLIDS: TOTAL	SOLIDS: SUSPENDED	CHLORIDES as Cl	SULFATES as SO_4	SILICA DIOXIDE as SiO_2	MANGANESE as Mn	IRON as Fe	ABS	COLOR	CARBON DIOXIDE as CO_2	CALCIUM as $CaCO_3$	SODIUM as Na	POTASSIUM as K	TOTAL HARDNESS as $CaCO_3$
11/29/65	3	7.8	185	47	48	13.1	1.1	.038	.033	.60	.10	188	138	19	28		.12	.27	<.01			56	25	2.7	76
12/13/65	5	7.9	890	44	160	12.6		0	.033	.90	.01	483	422	13	27		.41	.12	0			58	21	2.2	74
3/14/66	4	7.5	128	36	145	13.4	1.4	.290	.029	.78	.66	400	324	8	33		.23	.55	<.01			46	1	2.9	62
4/12/66		7.8	212	59					.008	.56	.44	131	64	18	34		.05	.40	<.01			72	11	1.9	104
5/23/66	16	7.9	284	72	25	7.0		.308	.011	.21	.22	240	36	19	34		.06	.20	<.01	15		80	25	2.0	112
6/27/66		7.8	333	103				.364	.009	.14	.27	221	22	35											143

Drainage Basin 4

Table VI-4 (cont'd.)

Stream Name Genesee River

Station Number 10

Stream Number Ont. 117

Stream Mileage 4.60

All values are in mg/l unless otherwise indicated

DATE COLLECTED	TEMPERATURE °C	pH	CONDUCTIVITY u mhos/cm	TOTAL ALK. as $CaCO_3$	TURBIDITY	DISSOLVED OXYGEN	BOD-5 DAY	NITROGEN as N			TOTAL PHOSPHATES as PO_4	SOLIDS		CHLORIDES as Cl	SULFATES as SO_4	SILICA DIOXIDE as SiO_2	MANGANESE as Mn	IRON as Fe	ABS	COLOR	CARBON DIOXIDE as CO_2	CALCIUM as $CaCO_3$	SODIUM as Na	POTASSIUM as K	TOTAL HARDNESS as $CaCO_3$
								AMMONIA	NITRITE	NITRATE		TOTAL	SUSPENDED												
12/11/63		7.6	400	93	10			.128	.008	.46	.24	375		47	90	3.6	.04	1.0	.08	5		156	31	3.0	200
7/13/64		7.4	370	96	12			.224	.016	.12	.17	308		40	55	1.3	<.01	.36	.08	17		140	25	1.0	172
10/19/64		7.6	450	100	17			.250	.016	.16	.20	374		45	86	1.0	.10	.70	.04	7		156	30	8.5	192
10/4/65		7.4	503	102							.52	311	16	44	26		.06	.70	<.01			147	53	2.3	192
11/12/65		7.7	405	120				.044	.015	.29	.66	472	19	57	134		.08	.12	.01			198	65	3.2	314
4/18/66		7.1	409	114	25	6.6	1.0	.554	.006	.42	.17	334	30	29	77		.05	.27	<.01	20		183	22	2.4	220
5/23/66		8.1	414	99				.550	.011	.25	.27	305	68	24	68		.09	.44	.01			147	31	2.2	188
6/27/66		7.6	372	103				.486	.020	.31	.40	258	33	33	64		.03	.41	.01			138	19	2.3	180

Drainage Basin 4
Station Number 30
Stream Mileage 2.8

Table VI-4 (cont'd.)

Stream Name Oatka Creek
Stream Number Ont. 117-25

All values are in mg/l unless otherwise indicated

DATE COLLECTED	TEMPERATURE °C	pH	CONDUCTIVITY u mhos/cm	TOTAL ALK. as $CaCO_3$	TURBIDITY	DISSOLVED OXYGEN	BOD-5 DAY	NITROGEN as N			TOTAL PHOSPHATES as PO_4	SOLIDS		CHLORIDES as Cl	SULFATES as SO_4	SILICA DIOXIDE as SiO_2	MANGANESE as Mn	IRON as Fe	ABS	COLOR	CARBON DIOXIDE as CO_2	CALCIUM as $CaCO_3$	SODIUM as Na	POTASSIUM as K	TOTAL HARDNESS as $CaCO_3$
								AMMONIA	NITRITE	NITRATE		TOTAL	SUSPENDED												
11/29/65	1	7.2	150	187	4	13.6	0.7	0	.004	.99	.10	72	13	45	518		.02	.05	.01			576	25	0.9	752
12/13/65	5	7.9	100	194	4	11.4		.02	.015	1.00	.19	540	5	44	555		0	.06	.01			535	28	3.5	482
1/3/66	4	7.5	492	102	15	12.2	2.2	.164	.016	1.25	.24	433	46	35	124		.04	.15	.01			210	38	2.8	268
3/14/66	4	7.8	462	111	15	12.8	1.6	.538	.014	.88	.25	299	25	26	141		.03	.22	.01			182	15	2.3	227
4/11/66		8.2	604	143				.270	.019	1.69	.12	475	15	30	213		.02	.03	.01			295	30	2.1	346
5/23/66	16	7.8	800	168	20	7.0		.540	.008	1.34	.13	619	11	33	297		.04	.04	.01	10		260	37	2.5	436
6/27/66		8.1	103	176				.364	.013	.92	.22	902	9	39	424		.02	.07	.01			463	23	2.5	478

Table VIII-4

WATER USES AND WATER QUALITY GOALS - GENESEE RIVER BASIN

Stream Sector	WATER USES															WATER QUALITY GOALS									
			Recreational			Fish and Aquatic Life				GENERAL															
	Municipal Water Source	Industrial Water - Self-Supplied	Whole Body Contact	Partial Body Contact	Irrigation	Group 1	Group 2	Group 3	Wildlife & Stock Watering	Hydroelectric Power	Commercial Shipping	Cooling Water	Waste Assimilation	Esthetics	DO (min) - mg/l	BOD 5-day - mg/l (max)	pH (range)	Coliform Guide (See Table VIII-2)	Soluble Phosphates (max) mg/l	Turbidity, Jackson Units (max)	Temp. (max) ^{o}F	Dissolved Solids (max) mg/l	Color Units (max)	New York State Stream Classification
Main Stem: Lake Ontario to Driving Park Bridge		X		P		P	X		P		P	P	P	P	4.0		6-9	B	0.03	250	82	750	50	*
Main Stem: Driving Park Bridge to Barge Canal		P		P			P		P	P	P	P	P	P	4.0		6-9	B	0.03	250	82	750	50	B, *
Main Stem: Barge Canal to Mt. Morris		P	X	P	P		P		P	X		X	P	P	4.0		6-9	A	0.03	250	82	750	50	B, C
Main Stem: Mt. Morris to Portageville	X	X	P	P			P		P	P		X	P	P	4.0		6-9	A	0.03	250	82	500	50	B
Main Stem: Portageville to Wellsville	P	X	X	P	X		P	X	P	X		X	P	P	5.0		6-9	A	0.03	250	68	500	15	C, C(T)
Main Stem: Above Wellsville	P	X		P	X			P	P	X		X	P	P	5.0		6-9	B	0.03	250	68	500	15	A(T),C(T)
Hemlock Lake	P			P			P	P	P					P	4.0		6-9	B		250	58	500	15	AA
Canadice Lake	P			P			P	P	P					P	4.0		6-9	B		250	58	500	15	AA

P = Present Uses X = Anticipated and/or possible uses that can be accommodated

* Reclassification hearing held for upgrading; classification pending Water Resources Commission decision.

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Table VIII-4 (continued)

WATER USES AND WATER QUALITY GOALS - GENESEE RIVER BASIN

Stream Sector	Municipal Water Source	Industrial Water - Self-Supplied	Whole Body Contact	Partial Body Contact	Irrigation	Group 1	Group 2	Group 3	Wildlife & Stock Watering	Hydroelectric Power	Commercial Shipping	Cooling Water	Waste Assimilation	Esthetics	DO (min) - mg/l	BOD 5-day - mg/l (max)	pH (range)	Coliform Guide (See Table VIII-2)	Soluble Phosphates (max) mg/l	Turbidity, Jackson Units (max)	Temp. (max) ^{o}F	Dissolved Solids (max) mg/l	Color Units (max)	New York State Stream Classification
Conesus Lake	P	P	P	P	X		P		P					P	4.0		6-9	A		250	82	500	15	AA
Silver Lake	P	P	P	P	X		P		P					P	4.0		6-9	A		250	82	500	15	A
Honeoye Lake	P	P	P	P	X		P		P					P	4.0		6-9	A		250	82	500	15	AA
Canaseraga Creek: Genesee River to Dansville		P		P	X		P		P				P	P	4.0		6-9	B		250	82	750	50	C, C(T)
Black Creek		P		P	P		P		P			X	P	P	4.0		6-9	B		250	82	750	50	C, B, D
Oatka Creek: Genesee River to LeRoy		P	P	P	X			P	P				P	P	5.0		6-9	A		250	58	750	50	B,B(T),C,D
Oatka Creek: LeRoy to Warsaw		P		P	X		P		P			P	P	P	4.0		6-9	B		250	82	750	50	B, C, D
Oatka Creek: Above Warsaw		P		P			P	X	P					P	5.0		6-9	B		250	58		50	C(T),A(T),A
Honeoye Creek: Genesee River to Lakes		P		P			P		P				P	P	3.0-4.0		6-9	B		250	82	50		C, B, D*

P = Present Use

X = Anticipated and/or possible uses that can be accomodated

Table IX-1

PRESENT MUNICIPAL WASTE TREATMENT CONSTRUCTION NEEDS

Genesee River Basin
(Communities over 500 Population)

COMMUNITY	ESTIM. POPULATION SEWERED/	UNSEWERED	PRESENT TREATMENT	CONSTRUCTION NEEDS
Andover		1,250	None	Collection, primary and secondary treatment
Angelica		900	None	Collection, primary and secondary treatment
Avon (1)	2,770		Primary	Secondary treatment
Belfast		650	None	Collection, primary and secondary treatment
Belmont (2)		1,160	None	Collection, primary and secondary treatment
Bergen	1,060	100	None	Primary and secondary treatment
Brighton #5 (3)	12,000		Primary	Secondary treatment
Caledonia	2,100		None	Primary and secondary treatment
Canaseraga		750	None	Collection, primary and secondary treatment
Castile (4)		1,240	None	Collection, primary and secondary treatment
Churchville (5)		1,000	None	Collection, primary and secondary treatment
Cuylerville		500	None	Collection, primary and secondary treatment
Dalton		750	None	Collection, primary and secondary treatment
Dansville	5,460		Primary	Secondary treatment
East Avon		650	None	Collection, primary and secondary treatment
Fillmore		530	None	Collection, primary and secondary treatment

Table IX-1 (Cont.)

COMMUNITY	ESTIM. POPULATION SEWERED/	UNSEWERED	PRESENT TREATMENT	CONSTRUCTION NEEDS
Friendship (6)	300	900	None	Collection, primary and secondary treatment
Gates-Chili-Ogden (7)	25,000		Primary	Secondary treatment
Geneseo	3,280		Secondary	None
Hemlock (8)		500	None	Collection, primary and secondary treatment
Honeoye		560	None	Collection, primary and secondary treatment
Honeoye Falls	2,550		Secondary	Advanced treatment
Houghton		1,100	None	Collection, primary and secondary treatment
Irondequoit (9)	8,500		Primary	Secondary treatment
Lakeville (10)		1,340	None	Collection, primary and secondary treatment
LeRoy	4,800		Primary	Secondary treatment
Lima (11)		1,500	None	Collection, primary, secondary and advanced treatment
Livonia (12)	1,050		Secondary	Advanced treatment
Mt. Morris (13)	3,250		Primary	Secondary treatment
Mumford	2,550	600	None	Collection, primary secondary and advanced treatment
Nunda (14)		1,220	None	Collection, primary and secondary treatment
Perry (15)	4,500			Primary, secondary and advanced treatment
Rush (16)		500	None	Collection, primary and secondary treatment
Scio		530	None	Collection, primary and secondary treatment
Scottsville (17)	2,000		Primary	Secondary treatment
Silver Lake		630	None	Collection, primary and secondary treatment

Table IX-1 (Cont.)

COMMUNITY	ESTIM. POPULATION SEWERED/UNSEWERED		PRESENT TREATMENT	CONSTRUCTION NEEDS
Silver Springs		725	None	Collection, primary and secondary treatment
Warsaw	3,650		Primary	Secondary and advanced treatment
Wayland (18)		2,000	None	Collection, primary, secondary and advanced treatment
Wellsville	5,970		Primary	Secondary treatment
West Bloomfield		500	None	Collection, primary and secondary treatment
Whitesville		500	None	Collection, primary and secondary treatment
York	300	1,100	Primary	Collection, primary and secondary treatment
Wyoming		580	None	Collection, primary and secondary treatment

(1) Avon - Under State Health Commissioner's Orders - Funds authorized for secondary treatment for both Avon and cannery wastes by General Foods.

(2) Belmont - Final plans submitted to State Health Department.

(3) Construction 90% completed for secondary treatment.

(4) Castile - Planning of treatment facilities in progress.

(5) Churchville - Preliminary planning complete.

(6) Friendship - Final plans completed and sent to State Health Department.

(7) Gates-Chili-Ogden - Within area of Monroe County Comprehensive Sewerage Study.

(8) Hemlock - Comprehensive Sewerage Study for this area completed.

(9) Irondequoit - Secondary treatment under construction.

(10) Lakeville - Comprehensive Sewerage Study completed.

(11) Lima - Secondary treatment plant plus tertiary under construction.

Table IX-1 (Cont.)

(12) Livonia - Comprehensive Sewerage Study completed.

(13) Mt. Morris - Under State Health Commissioner's Orders.

(14) Nunda - Final plans submitted to State for approval.

(15) Perry - Under State Health Commissioner's Order.

(16) Rush - Monroe County Comprehensive Sewerage Study underway.

(17) Scottsville - Project awaiting State and Federal funds.

(18) Wayland - Preliminary plans completed.

ATTACHMENT A for APPENDIX H (Water Supply

and Water Quality Management)

of the

GENESEE RIVER BASIN COMPREHENSIVE STUDY

DURATION, FREQUENCY, AND DISTRIBUTION OF STREAMFLOW IN THE GENESEE RIVER BASIN

With Emphasis on Low Flows

by

Bruce K. Gilbert

Prepared by

UNITED STATES DEPARTMENT OF THE INTERIOR

GEOLOGICAL SURVEY

in cooperation with the

NEW YORK STATE CONSERVATION DEPARTMENT

DIVISION OF WATER RESOURCES

for

U.S. Army Engineer District, Buffalo

Corps of Engineers

Buffalo, New York 14207

1967

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DURATION, FREQUENCY, AND DISTRIBUTION OF STREAMFLOW IN THE GENESEE RIVER BASIN
With Emphasis on Low Flows

By Bruce K. Gilbert

ABSTRACT

The Genesee River basin contains about 2,400 square miles in western New York and about 90 square miles in Pennsylvania. Streamflow data have been collected in the basin for periods up to 60 years, and together with information secured in 1964 and 1965, form the foundation for the analyses presented in this report.

Average annual runoff totals about 14 inches with a basin-wide range of 10 to 20 inches. Throughout the basin, average annual runoff is consistently about 20 inches less than precipitation.

During a basin-wide reconnaissance of streams in September and October 1964, streamflow varied from no flow to a maximum of about 3.0 csm (cubic feet per second per square mile). Results of low-flow frequency studies were combined with information collected during this reconnaissance to develop a map showing the areal distribution of average low flow for a 7-day period having a recurrence interval of 2 years. Results of other studies indicate that: (1) if base-flow conditions exist, discharges can be estimated after periods of no rainfall for up to 80 days by use of base-flow recession curves; (2) many streams in the basin have sufficient discharge to supply large quantities of water even through normal periods of low flow; (3) duration curves of daily flow by months follow an orderly seasonal progression with lowest flow occurring from July through October and the highest in March and April; and (4) the median discharges that occur from July through October range from about one-half to one-seventh of the median discharge for all months during the same period of years.

INTRODUCTION

This report has been prepared by the U.S. Geological Survey for inclusion in the overall report of Task Group No. 4 on "Ground-water and quality of water studies," as outlined by the Genesee River Basin Coordinating Committee (1964). Consequently, the report holds closely to the scope of investigations as stated in the plan of survey and is a preliminary evaluation of the data collected thus far.

The Geological Survey has compiled and analysed data in order to provide as complete a picture as possible of the surface-water situation in the Genesee River basin. To meet the specified needs of the agencies participating in the study, heavy emphasis is placed on the investigation of low streamflow. Some information on high flows is also available and may be obtained by contacting the District Chief, U.S. Geological Survey, Water Resources Division, P. O. Box 948, Albany, New York 12201.

The work of the Geological Survey is divided into two phases: the first, participation in the comprehensive basin plan (Genesee River Basin Coordinating Committee, 1964), through technical contributions to three task groups; and the second, to make an overall evaluation of both the ground- and surface-water resources of the Genesee River basin. Most of the first phase was carried out in 1964 and 1965. Although the phase-two report, scheduled for completion early in 1967, will contain and refer to data in the U.S. Geological Survey phase-one reports, it will mainly emphasize the relationships among the hydrologic features of the basin. Because the overall report will be a more thorough and integrated treatment of the hydrology of the basin, it will contain more refinements and material not presented in this preliminary report.

Purpose and Scope

As a participant in the Genesee River basin study under Task Group No. 4, the U.S. Geological Survey has: (1) made available to other agencies those surface-water quality records that were not yet in published form at the outset of the study; (2) furnished existing and new information on streamflow to cooperating agencies as and when requested; (3) provided basin-wide coverage of streamflow; and (4) developed flow-duration, frequency, and other hydrologic interpretations from the basic data. To meet these objectives, 15 existing gaging stations were maintained, and 8 new stream-discharge stations and 2 new lake-stage stations were established in 1963 and 1964. About 75 additional sites were selected at which low-flow discharges were measured to broaden the coverage afforded by the gaging stations. Base flow (that streamflow which is derived from ground-water discharge or as release from surface storage, but not from direct runoff) was measured or observed at many sites under nearly constant conditions to provide data for studies of stream pollution and the evaluation of basin-wide distribution of flow.

Also, time-of-travel studies were made on reaches of several streams in the basin as requested and financed by participating agencies. The Geological Survey has prepared a separate report on these analyses for the convenience of the agencies involved.

Acknowledgments

For purposes of this study, the Geological Survey established 5 new gaging stations in cooperation with the New York State Conservation Department, Division of Water Resources, and 4 new gaging stations in cooperation with the U.S. Corps of Engineers.

This study itself has been carried out in cooperation with the New York State Conservation Department, Division of Water Resources.

Valuable assistance was received from the U.S. Weather Bureau at Rochester, N. Y. throughout the course of the investigation.

MAN'S INFLUENCE ON THE WATER SITUATION IN THE GENESEE RIVER BASIN

In the course of a water-resources investigation, it is usually necessary to be concerned with the regulated or "non-natural" occurrence and behavior of water as well as with the natural hydrology. The situation in the Genesee River basin is no exception. Historically, for some 200 years the streams and lakes in the basin have been utilized by the various inhabitants for transportation, power developments of one kind or another, water supplies, irrigation, and for recreation.

The extent of the area of study is shown in figure 1. At present there are six communities in the basin with a population of over 5,000. These are Wellsville, Dansville, Perry, Caledonia, Batavia, and Rochester, all in New York.

Man's activities in today's world invariably change the quality, quantity, and distribution of the water available to him. Water that nurtures his life, helps to produce his food, manufacture his products, and dispose of his wastes is usually in a somewhat poorer condition afterward. Sometimes natural processes can restore this water to its former state; sometimes man must do the restoring himself.

It often follows that the greater the density of a region's population, the more effect this population will have on the water of the region. Parker and others (1964, p. 11) describe the effects of urbanization on hydrology in this manner: "The growth of urban areas is one of the greatest forces affecting water supplies. It brings many changes which have local and even regional effects on the occurrence and use of water. The net effect is difficult to evaluate and undoubtedly varies a great deal both in place and time." According to Parker and others (1964, p. 11), some of these changes are:

1. Water use increases sharply, except in areas formerly irrigated.

2. Scattered small ground-water supplies are replaced largely by a single public surface-water supply, or ground-water withdrawals may be multiplied by numerous privately or municipally owned wells.

3. Large areas are covered by roofs and pavements which intercept precipitation and thus tend to increase runoff, especially in the form of sudden, concentrated discharge; this change in runoff characteristics tends to reduce ground-water recharge.

4. Storm-drainage systems provide rapid runoff and decrease ground-water recharge, except as noted in item 6.

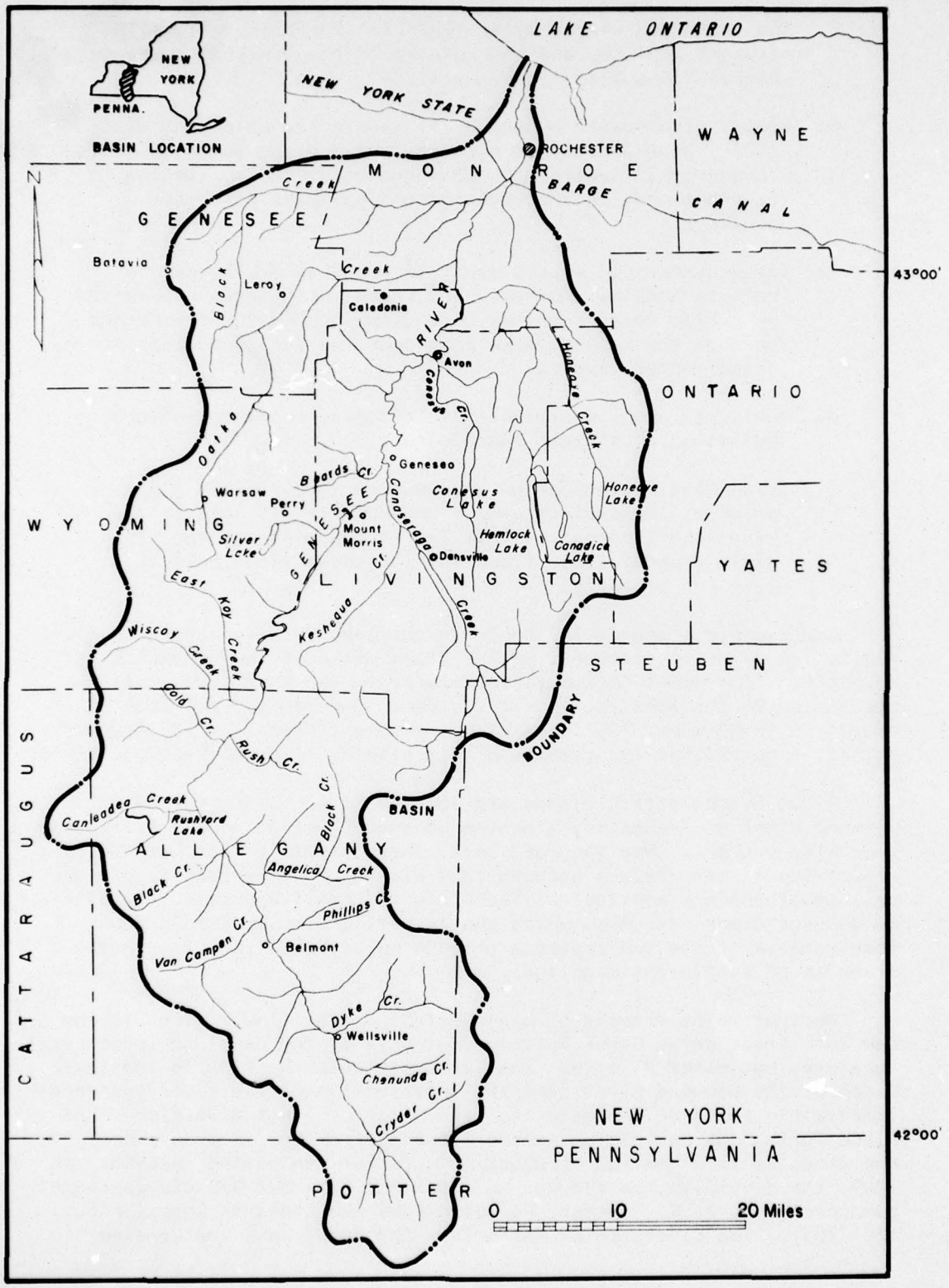

Figure 1. Map of the Genesee River basin.

5. The increased use of water tends to cause lower flows in drought periods, and the more rapid runoff tends to cause higher flood flows in wet periods.

6. Sewers often develop leaks. If sewers are below the water table, ground water is drained away and the water table is lowered. If sewers are above the water table, leaking sewerage adds to the recharge and pollutes affected aquifers.

7. Large numbers of septic tanks in suburban areas tend to pollute shallow aquifers, and where these areas are served by public water supplies, the "imported" water discharged through the septic tanks recharges the local aquifers and raises water levels.

8. Municipal and industrial waste disposal tends to increase pollution of streams and aquifers.

9. Urban developments often encroach on stream flood plains which are natural waterways and an integral part of the river's discharge system. The encroachment on the flood plain impedes flood flows and increases flood hazards to life and property.

One example of man's influence in the Genesee River basin is Mount Morris Dam. The encroachment on the flood plain of the Genesee River downstream from Mount Morris (particularly in the Rochester area) was one factor in the construction of the dam. The dam was put into operation in November 1951 and, with a usable capacity of 337,000 acre-ft, has accomplished its purpose of diminishing flood hazards downstream.

Eight hydroelectric plants are located in the basin; 3 are on the Genesee River at Rochester, 1 on the Genesee River at Mount Morris, and 2 on Wiscoy Creek. For the most part, these plants do not materially affect the stream regimen because they are the run-of-river type with only small pondage available. There are two small hydroelectric plants on Conesus Creek near Avon which supply part of the household power requirements of the two separate private owners when the flow in the creek is of sufficient magnitude.

Another major example of man's effect on the flow regimen is the New York State Barge Canal System. Not only is the canal an important waterway, but water diverted from it supplements the flow in the lower reach of the Genesee River from the intersection of the river and canal immediately south of Rochester to Lake Ontario. This diversion takes place during the navigation season (usually from May into November) and amounted to a maximum of about 600 cfs for the period 1926-48. In 1949, the diversion was reduced to a maximum of about 375 cfs (personal communication, R. W. Gunther, Rochester Gas and Electric Corp., Feb. 12, 1965). The diversion of water from the canal into the Genesee

River is primarily for hydroelectric plant operation at Rochester, but provides a secondary benefit in the dilution of wastes both from Rochester's industries and from an expanding population.

The channel of the Genesee River has been improved for navigation a short distance both north and south of the junction with the canal. The northernmost and final 3 miles of the Genesee River in Rochester Harbor is part of the Great Lakes - St. Lawrence Seaway commercial shipping system and, as such, is maintained as a navigation channel.

Many of the lakes in the basin are used as sources of water supplies. In some cases there is a regulating structure on the lake outlet and in others outflow is not directly controlled but is affected by the volume diverted. Among the larger lakes in the basin are Silver, Conesus, Hemlock, Honeoye, and Canadice. Rushford Lake is a privately owned impoundment used to regulate flows through Caneadea Creek to supply hydroelectric plants downstream on the Genesee River.

BASIC DATA

Types of Data Collection Sites

Three types of surface-water data collection sites have been established in the Genesee River basin. They are:

1. Gaging stations: particular sites on a stream, lake, or reservoir where systematic observations of gage height or discharge are obtained, usually on a daily or continuous basis.

2. Partial-record stations: particular sites where limited or selected streamflow data are collected over a period of years for use in hydrologic analyses. These include stations for investigations of both peak stages and low flow.

3. Miscellaneous sites: particular sites where streamflow data are collected on a periodic (or sometimes "one-shot") basis for a special purpose, usually low-flow analyses.

Downstream Order and Station Numbers

Table 1 lists all gaging stations, partial-record stations, and miscellaneous measuring sites in the basin. The sites are listed in the standard downstream order as used by the Geological Survey in the publication of streamflow data.

To facilitate identification of the basic data, station numbers as used in the annual series of U.S. Geological Survey water-supply papers and open-file reports entitled "Surface Water Records of New York," are also listed in table 1. These numbers do not indicate a distinction among station types; therefore, the type of data collected at each site is shown in a separate column. It can be noted that gaps have been left between numbers to allow for new stations that may be established; hence, the numbers are not consecutive. For more convenient reference, table 2 has been provided to indicate the respective periods of operation for all gaging stations in the basin, active or discontinued.

Plate 1 shows the location of all gaging and partial-record stations, and selected miscellaneous sites in the basin for which data are available.

More complete information on location, records available, and other pertinent data for gaging stations, partial-record stations, and selected miscellaneous sites in the Genesee River basin are given in the appendix, section 1.

Table 1.--Surface-water data collection sites in the Genesee River basin (all stations in New York except as noted)

Note: GS = gaging station; Misc = miscellaneous site; Res = reservoir; PR = partial-record station; CS = crest stage, LF = low flow; D = discontinued

Station number	Type of site	Stream and location
2203	Misc	Genesee River at Hickox, Pa.
2203.1	Misc	Middle Branch Genesee River at Hickox, Pa.
2203.4	Misc	West Branch Genesee River at Genesee, Pa.
2203.5	Misc	Genesee River at Genesee, Pa.
2203.7	PR,LF	Cryder Creek at Paynesville
2203.88	Misc	Marsh Creek at Stone Dam
2203.89	Misc	Marsh Creek Tributary at Mapes
2203.9	PR,LF	Marsh Creek at Mapes
2204.1	PR,LF	Ford Brook at Stannard
2204.3	PR,LF	Chenunda Creek at Stannards Corners
2204.5	PR,LF-CS	Dyke Creek near West Greenwood
2204.55	PR,LF-CS	Quig Hollow Brook near Andover
		Railroad Brook:
		Marsh Creek:
2204.6	PR,LF-CS	Marsh Creek Tributary near Andover
2204.65	PR,LF-CS	Railroad Brook near Alfred
2204.7	GS	Dyke Creek near Andover
2204.8	PR,LF-CS	Elm Valley Creek near Elm Valley
2205	GS-D;PR,LF-CS	Dyke Creek at Wellsville
2210	GS-D	Genesee River at Wellsville
2212	PR,LF	Brimmer Brook near Wellsville
2215	GS	Genesee River at Scio
2215.1	PR,LF	Vandermark Creek near Scio
2215.2	PR,LF	Knight Creek at Scio
2215.3	Misc	Gordon Brook at Scio
2215.6	PR-LF	Phillips Creek near Belmont
2216	GS(was PR,LF)	Van Campen Creek at Friendship
		Angelica Creek:
2216.5	PR,LF	Black Creek at Bennetts
2217	PR,LF	Angelica Creek near Angelica
2217.1	PR,LF	Baker Creek near Angelica
2217.2	GS	Angelica Creek at Transit Bridge
2217.6	PR,LF	White Creek near Belfast
2218	PR,LF	Black Creek at Rockville
2218.1	PR,LF	Wigwam Creek at Belfast
2218.2	GS	Genesee River at Belfast
2218.3	PR,LF	Crawford Creek at Oramel
2219	Misc	Caneadea Creek at Rushford
2219.4	Misc	Caneadea Creek Tributary at Rushford
2219.7	Misc	Rush Creek at McGrawville
2219.9	Res	Rushford Lake
2220	GS	Caneadea Creek at Caneadea
		Cold Creek:
		Sixtown Creek:
2225	GS-D	Lost Nation Brook near Centerville

Table 1.--Surface-water data collection sites in the Genesee River basin (Cont'd.)

Station number	Type of site	Stream and location
2225.15	Misc	Sixtown Creek at Hume
2225.3	PR,LF	Cold Creek at Hume
2225.35	Misc	Rush Creek near Fillmore
2225.4	PR,LF	Rush Creek at Fillmore
2226	PR,LF-CS	Wiscoy Creek at Bliss
2226.8	PR,LF	Trout Brook at Pike Corners
2227	PR,LF	Wiscoy Creek at Pike
2229	GS	East Koy Creek at East Koy
2229.3	Misc	Wiscoy Creek at Rossburg
2230	GS	Genesee River at Portageville
2234	PR,LF	Wolf Creek near Castile
2235	GS-D	Genesee River at St. Helena
2239	Res	Silver Lake
2239.5	Misc	Silver Lake Outlet near Ridge
2240	GS,Res	Mt. Morris Reservoir near Mount Morris
2245	GS-D	Genesee River at Mount Morris
		Canaseraga Creek:
2245.5	PR,LF-CS	Ewart Creek at Swain
2246.5	GS	Canaseraga Creek near Canaseraga
2247	PR,LF-CS	Sugar Creek near Ossian
2247.5	Misc	Sugar Creek near Moraine
2248	PR,LF-CS	Stony Brook at South Dansville
2248.1	PR,LF-CS	Sponable Creek near South Dansville
2248.5	Misc	Stony Brook near Stony Brook Glen
2249	PR,LF-CS	Mill Creek at Patchinville
2249.8	Misc	Mill Creek at Dansville
2250	GS	Canaseraga Creek near Dansville
2255	GS	Canaseraga Creek at Groveland
2256	PR,LF	Bradner Creek at Woodsville
		Keshequa Creek:
2259	Misc	Newville Creek near Barkertown
2260	GS-D;PR,LF	Keshequa Creek at Craig Colony, Sonyea
2265	GS-D	Keshequa Creek near Sonyea
2270	GS	Canaseraga Creek at Shakers Crossing
2275	GS	Genesee River at Jones Bridge near Mount Morris
2276	PR,LF	Beards Creek at Cuylerville
2276.5	PR,LF	Jaycox Creek near Geneseo
2279	PR,LF	Christie Creek near Canawaugus
2279.8	GS,Res	Conesus Lake near Lakeville
2279.9	Misc	Wilkins Creek at Tuxedo Park
2279.95	Misc	Conesus Creek at Lakeville
2280	GS-D	Conesus Creek near Lakeville
2283	Misc	Conesus Creek at Ashantee
2285	GS	Genesee River at Avon
2285.2	PR,LF	White Creek at Canawaugus
2285.5	PR,LF	Dugan Creek at Maxwell
2288.45	GS	Honeoye Lake near Honeoye

Table 1.--Surface-water data collection sites in the Genesee River basin (Cont'd.)

Station number	Type of site	Stream and location
2288.5	Res	Honeoye Lake at Outlet
		Honeoye Creek:
2288.55	PR,LF	Mill Creek at Honeoye Park
2289	GS	Springwater Creek at Springwater
2289.2	Res	Hemlock Lake at Outlet
		Hemlock Lake Outlet:
2289.5	GS,Res	Canadice Lake near Hemlock
2290	GS	Canadice Lake Outlet near Hemlock
2293.3	Misc	Bebee Creek at Idaho
2295	GS	Honeoye Creek at Honeoye Falls
2297	PR,LF	Spring Brook at Moran Corner
2300	GS-D	Honeoye Creek at East Rush
2300.5	PR,LF	Honeoye Creek Tributary near Rush
		Oatka Creek:
2303.1	PR,LF	Warner Creek at Rock Glen
2303.5	Misc	Oatka Creek Tributary at South Warsaw
2303.6	PR,LF	Stony Creek at Warsaw
2303.8	GS	Oatka Creek at Warsaw
2304	PR,CS	Oatka Creek at Pearl Creek
2304.1	PR,LF	Pearl Creek at Pearl Creek
2304.3	Misc	Oatka Creek near Roanoke
2304.8	Misc	Oatka Creek near Lime Rock
2304.9	PR,LF-CS	Spring Creek at Mumford
2305	GS	Oatka Creek at Garbutt
2306	Misc	Genesee River at Ballantyne Bridge near Mortimer
		Black Creek:
2307	Misc	Bigelow Creek near South Byron
2308	PR,LF	Spring Creek at Pumpkin Hill
2310	GS	Black Creek at Churchville
2310.5	PR,LF	Hotel Creek near Churchville
2311	PR,LF	Mill Creek near West Chili
2312	Misc	Black Creek near Genesee Junction
(2186.5)	Misc	Erie (Barge) Canal near Gates Center
2314	PR,LF	Red Creek near Rochester
(2188)	Misc	Erie (Barge) Canal at West Brighton
2315	GS-D	Genesee River at Rochester
2320	GS	Genesee River at Driving Park Ave., Rochester

Table 2.--Length of gaging-station records in the Genesee River basin (stations listed in downstream order)

Legend

Streamflow Stage (or volume)

Period of record (1910, 1920, 1930, 1940, 1950, 1960)	Gaging station	Station number
	Dyke Creek near Andover	2204.7
	Dyke Creek at Wellsville	2205
	Genesee River at Wellsville	2210
	Genesee River at Scio	2215
	Van Campen Creek at Friendship	2216
	Angelica Creek at Transit Bridge	2217.2
	Genesee River at Belfast	2218.2
	Caneadea Creek at Caneadea	2220
	Lost Nation Brook near Centerville	2225
	East Koy Creek at East Koy	2229
	Genesee River at Portageville	2230
	Genesee River at St. Helena	2235
	Mt. Morris Reservoir near Mt. Morris	2240
	Genesee River at Mt. Morris	2245
	Canaseraga Creek near Canaseraga	2246.5
	Canaseraga Creek near Dansville	2250
	Canaseraga Creek at Groveland	2255
	Keshequa Creek at Craig Colony, Sonyea	2260
	Keshequa Creek near Sonyea	2265
	Canaseraga Creek at Shakers Crossing	2270
	Genesee River at Jones Bridge near Mt. Morris	2275
	Conesus Lake near Lakeville	2279.8
	Conesus Creek near Lakeville	2280
	Genesee River at Avon	2285
	Honeoye Lake near Honeoye	2288.45
	Springwater Creek at Springwater	2289
	Canadice Lake near Hemlock	2289.5
	Canadice Lake Outlet near Hemlock	2290
	Honeoye Creek at Honeoye Falls	2295
	Honeoye Creek at East Rush	2300
	Oatka Creek at Warsaw	2303.8
	Oatka Creek at Garbutt	2305
	Black Creek at Churchville	2310
	Genesee River at Rochester	2315
	Genesee River at Driving Park Avenue, Rochester	2320

Explanation of Data Available

The following explanation is from an open-file report (U.S. Geological Survey, 1964), but has been modified slightly to better describe conditions and methods applicable to the Genesee River basin.

The basic data collected at gaging stations consist of records of stage and measurements of discharge. In addition, observation of factors affecting the stage-discharge relation, weather records, and other information are used to supplement the basic data in determining the daily flow. Records of stage are obtained from a water-stage recorder that gives a continuous chart of the fluctuations or from direct readings of a nonrecording gage. Measurements of discharge are made with a current meter by the general methods adopted by the Geological Survey on the basis of experience in stream gaging since 1888. These methods are described by Corbett and others (1943) and are also outlined in standard textbooks on the measurement of stream discharge.

Rating tables giving the discharge for any stage are prepared from stage-discharge relation curves defined by discharge measurements. If extensions to the rating curves are necessary to define the extremes of discharge, they are made on the basis of indirect measurements of peak discharge (such as slope-area or contracted-opening measurements, or computation of flow over dams or weirs), velocity-area studies, and logarithmic plotting. The daily mean discharge is determined by entering the rating table for a particular gaging station with the daily mean gage height from the recorder chart. If the stage-discharge relation is subject to change because of frequent or continual change in the physical features of the control, the daily mean discharge is determined by the shifting-control method in which correction factors based on individual discharge measurements and notes by engineers and observers are used in applying the gage heights to the rating tables. If the stage-discharge relation for a station is temporarily changed by the presence of aquatic growth or debris on the control, the daily mean discharge is computed by what is in effect the shifting-control method.

At some stations the stage-discharge relation is affected by changing stage. For such stations, the rate of change in stage is used as a factor in determining discharge.

During brief periods of ice effect or missing record, discharge is estimated on the basis of available record, temperature, and precipitation data, notes by gage observers and engineers, and from comparable records of discharge for other nearby stations.

Records are published for the water year which begins on October 1 and ends on September 30.

Much of the data and computations contained in this report has been

averaged, adjusted, and extended to the period 1931-60, as necessary, for comparative purposes.

The period 1931-60 has been chosen for standard reference to agree with the 30-year climatological standard periods adopted by the World Meteorological Organization in the late 1950's (Busby, 1963, p. S1). While there is no great hydrologic significance attached to this period, it does include both severe droughts and high floods.

DURATION OF STREAMFLOWS

The range in variability of streamflow is related to the time period under consideration; flows vary from day to day and from year to year. This natural fluctuation can be expressed by a flow-duration curve. A duration curve is a composite picture of the daily streamflows that have occurred during a specified period and shows the percentage of time within that period for which any particular daily discharge was equaled or exceeded. If the period is relatively long so that it includes both periods of low flow and floods, the duration curve may be used to indicate the percentage of time that any given discharge will be equaled or exceeded at a site, assuming that no change in regimen of the stream has been brought on by regulation or change in climate.

Figure 2 illustrates some typical duration curves. From the duration curve of daily flow for the period 1931-60, it may be seen that by proceeding vertically up the 90-percent line, the curve is intersected at a discharge of 32 cfs. This means that 90 percent of the time (or on an average of 9 days out of 10 over an extended period of several years) a flow of 32 cfs or more may be expected at this site. Similarly, the 50-percent line indicates that about 170 cfs or more may be expected at least half the time over any extended period.

Figure 2 also shows the effect of wet and dry years. Curves for the 1934, 1939, and 1956 water years were drawn for comparison with the curve for the period 1931-60. The variability shown is an indication of the risk involved in using a short-term period as a base for a duration curve. It also indicates that comparison of one or more stations by use of duration curves must have concurrent periods of records as a base. To accomplish this, the standard period, 1931-60, has been selected for this study. For sites on streams with shorter periods of record, data for the standard period were obtained by correlation studies with long-term stations. Stations selected for correlation were chosen on the basis of similarities in rainfall pattern, topography, and geology.

Although the curves in figure 2 vary considerably, the mean discharge for each period occurs within a narrow band of from 26 to 28 percent. Similar data for other stations in the basin do not show as close a relationship of duration to mean annual discharge. However, mean annual discharges for the standard period at unregulated long-term stations fall in a range of 26 to 29 percent with an average of about 28 percent.

The shape and slope of a duration curve indicate hydrologic conditions in the drainage basin. A curve with a steep slope indicates a "flashy" stream mostly supplied by overland runoff. A flat slope shows the effect of ground- or surface-water storage and, therefore, a less variable flow. A change in slope of a curve may be caused by a change in stream regimen of the basin, either by some process of nature or by the activities of man.

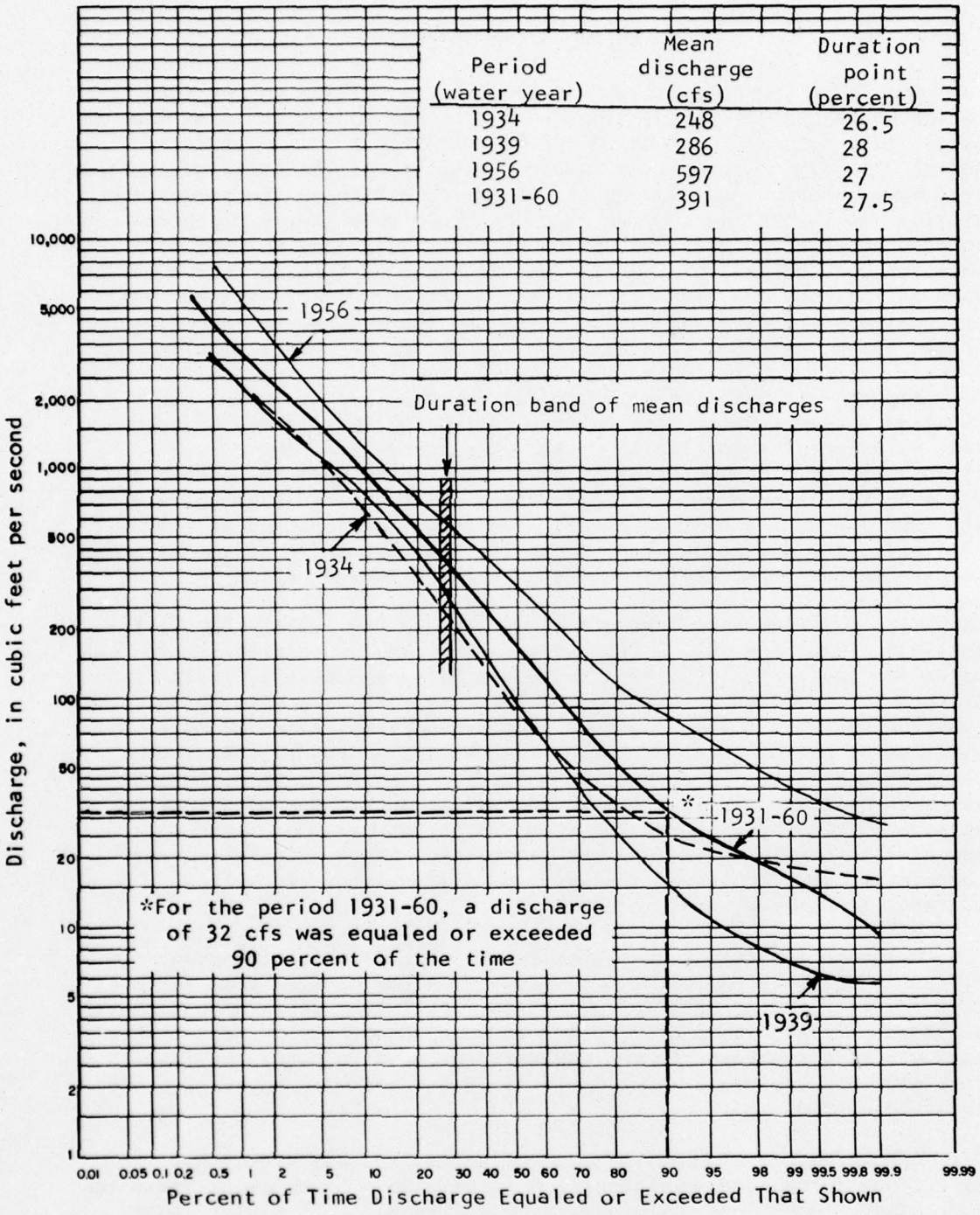

Figure 2. Duration curves of daily flow for Genesee River at Scio, N. Y.

It can be noted from figure 3 that in the 80 to 99 percent range, there is considerable difference in the lower ends of the curves. The higher flows of Oatka Creek at Garbutt reflect the sustaining effect of the springs in the Caledonia - Mumford area. The lower flows of Black Creek at Churchville probably are caused by infiltration of water from the stream into the porous limestone that underlies a part of the basin.

Figure 4 shows a profile of durations of flow for the Genesee River. The curves are based upon flow-duration data for gaged sites on the main stem and data for the intervening areas estimated by extending duration curves for tributary stations to their respective mouths on the basis of drainage-area ratios. The diversion from the Barge Canal to the river may be noted at the downstream end of the plot.

Flow-duration curves for gaging stations with short periods of record, for partial-record stations, and for selected miscellaneous sites were estimated on the basis of a technique described by Hunt (1963). Data developed for all sites are listed in section 1 of the appendix.

Duration Studies of Daily Flow by Months and Season

The duration curve is a tool used in water investigations, but is, however, a limited type of analysis because it provides no chronological sequence of flows. Some chronological consideration is often necessary in water developments because of the seasonal aspect of such operations as irrigation and vegetable canning industries. For this reason, monthly and seasonal flow-duration curves have been prepared.

Duration curves of daily flow by months were plotted from standard tabular data processed by computer, but only selected curves are included in this report. These data have not been adjusted to the standard 1931-60 base period because of limitations in time and personnel.

Figure 5 shows the duration curves of daily flows for each of the 12 months for Black Creek at Churchville. The curves follow an orderly seasonal progression; starting with August and September, each successive month moves to a higher position through March and then starts a trend downward.

Duration curves of daily flows by months for Genesee River at Scio and for Oatka Creek at Garbutt showed similar distributions of the curves as in figure 5. Because these three stations seem to indicate the varying hydrologic conditions found in the basin (fig. 3), and because of the similarity in the seasonal fluctuations of the flow-duration curves, durations of daily flow were plotted as representative of the basin for the low-flow months of July through October and for the total period July through October. Examples of these curves are shown in figures 6 and 7. The duration curve of daily flow for the full period is also shown in figure 7 for comparison to indicate the magnitude of the difference that might be expected by referring to one

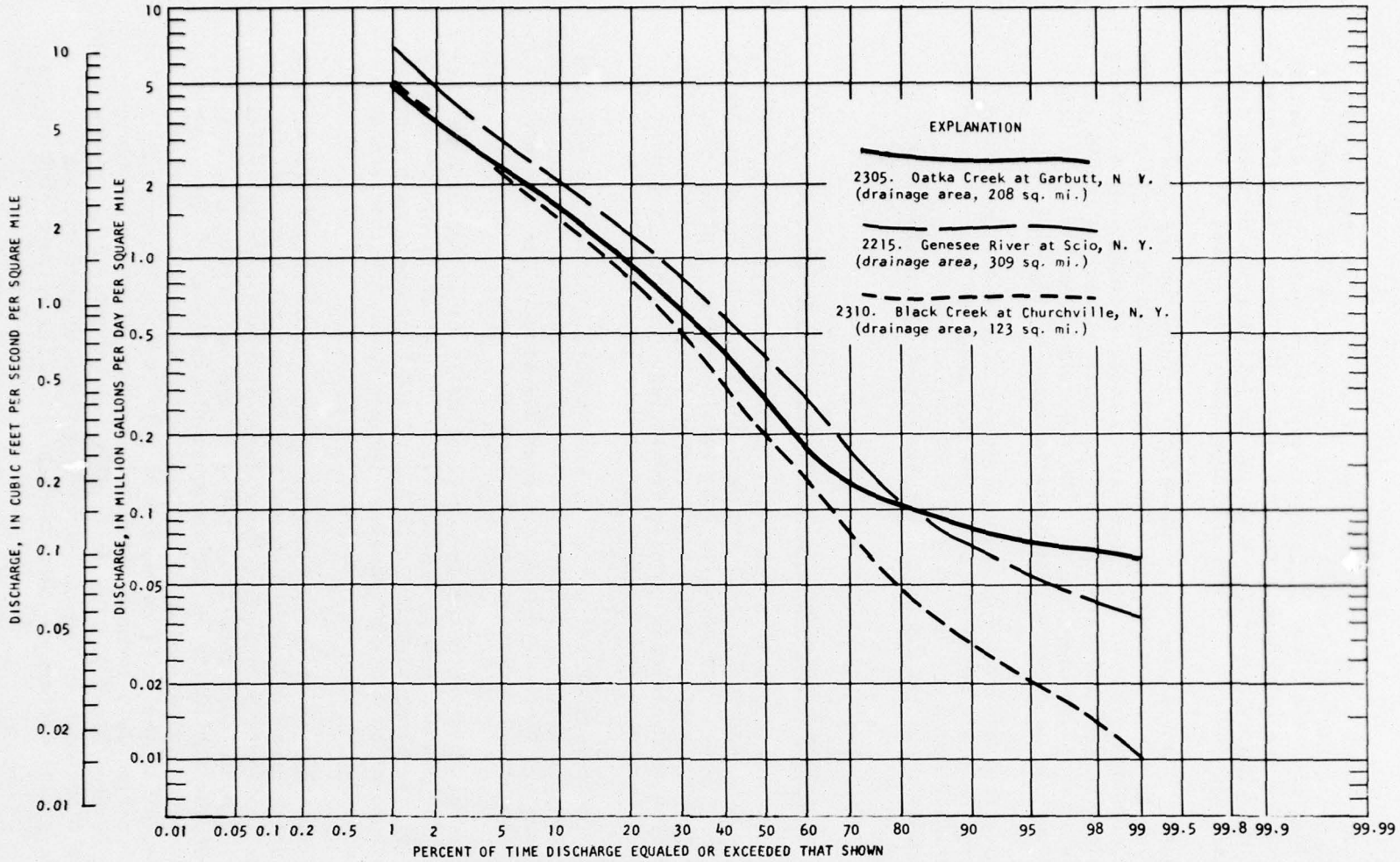

Figure 3. Duration curves of daily flow for three streams in the Genesee River basin for the period 1946-60.

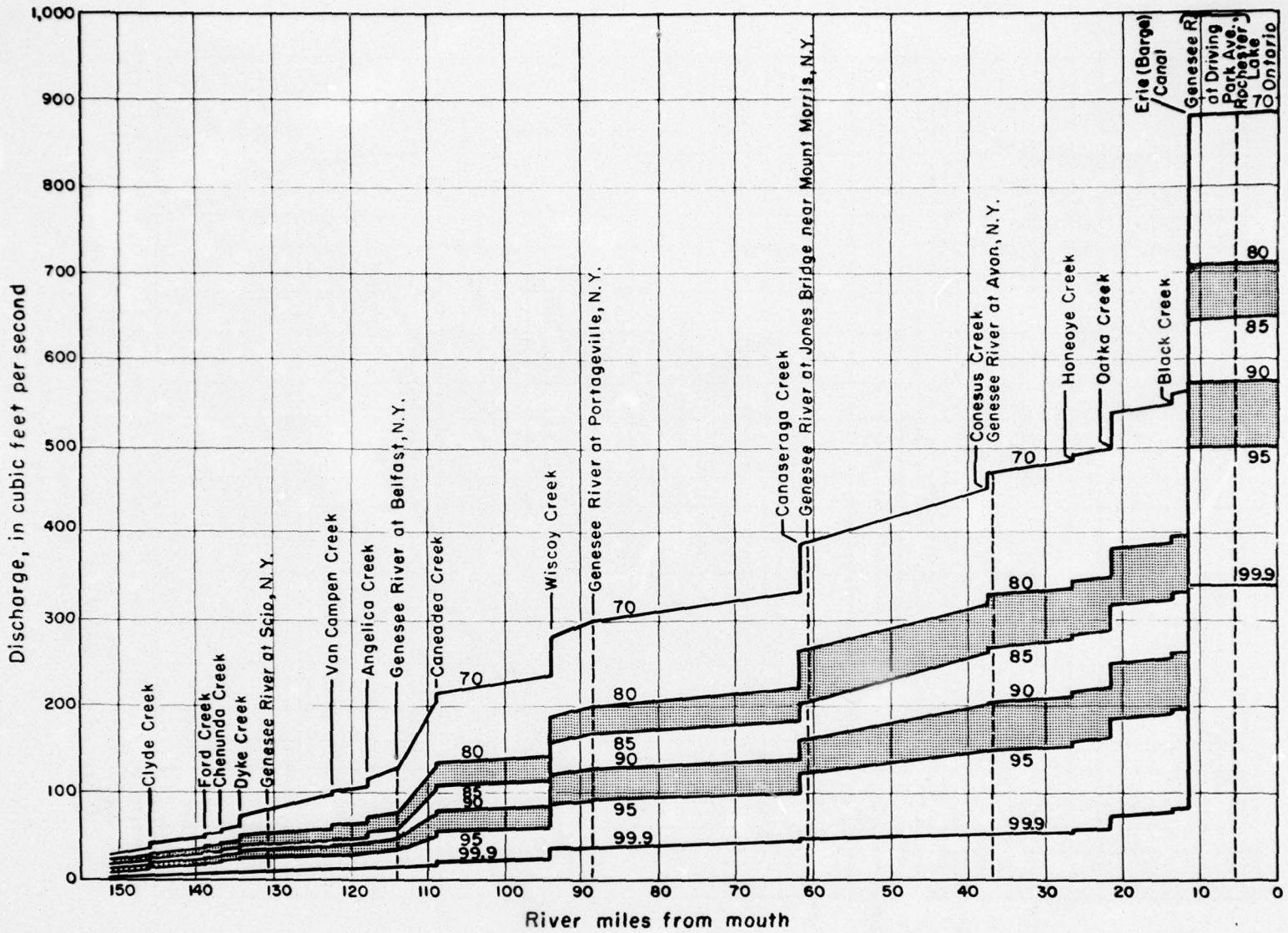

Figure 4. Profile of durations of flow for the Genesee River.

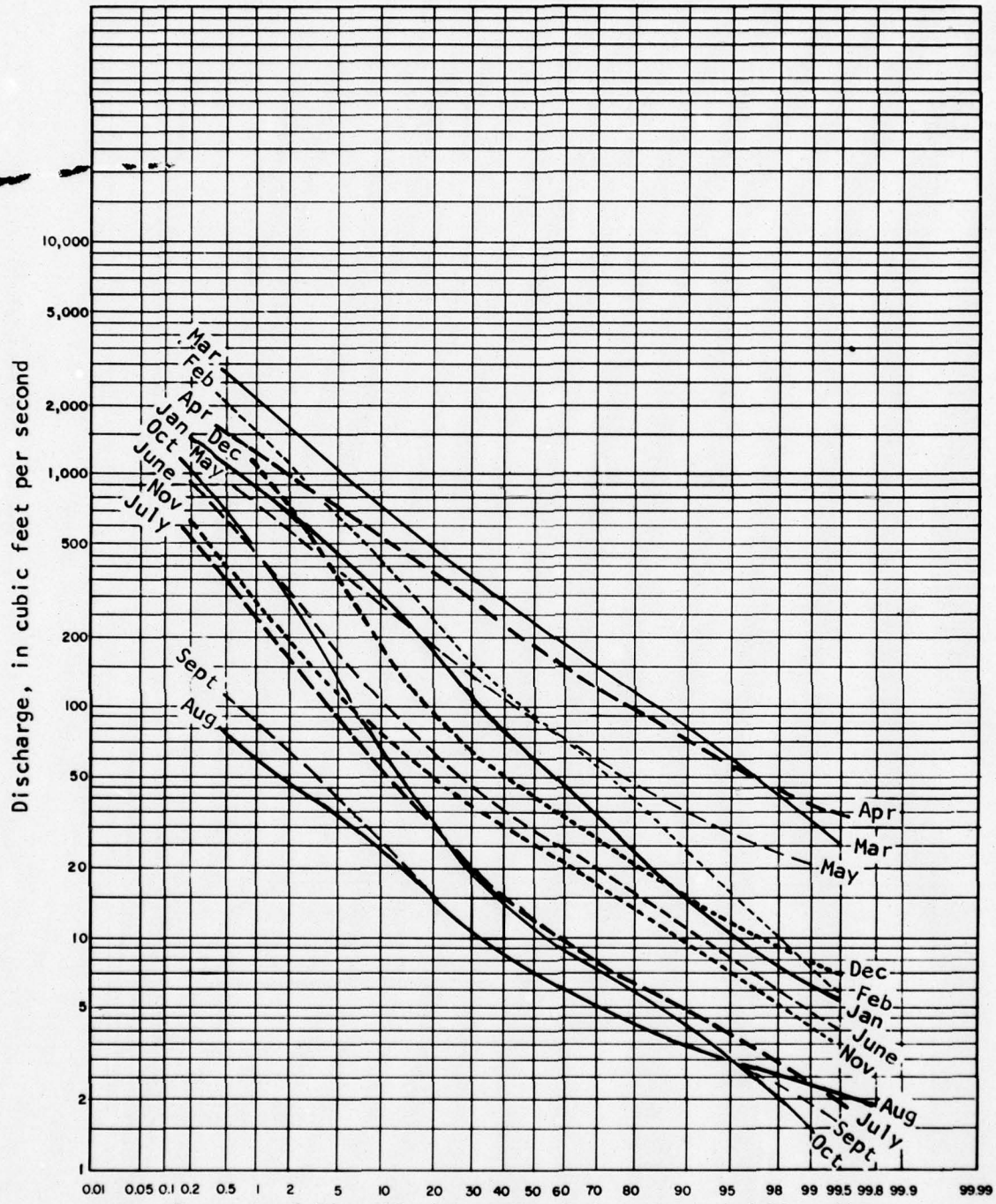

Figure 5. Duration curves of daily flow by months for Black Creek at Churchville, N. Y., for period 1946-58.

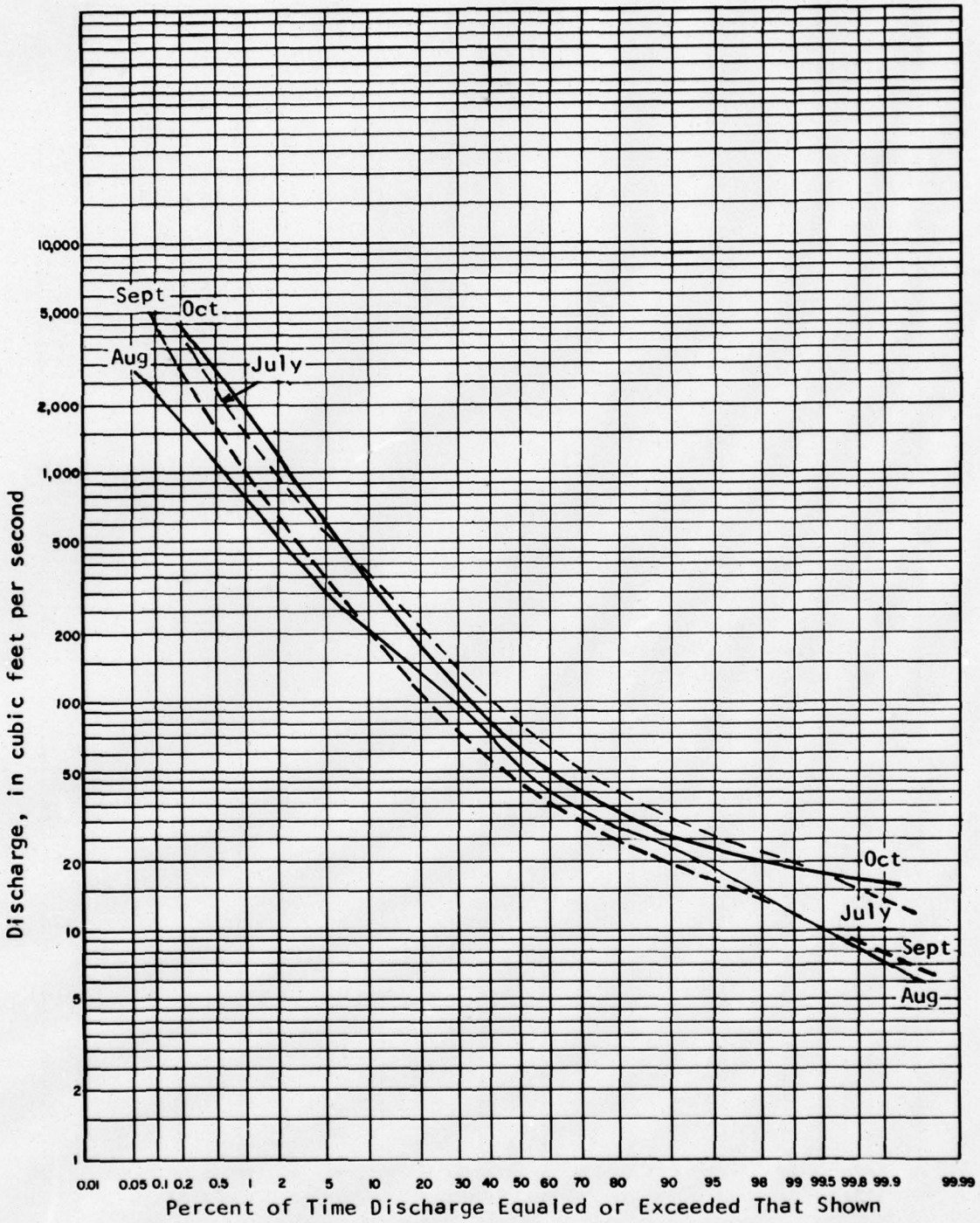

Figure 6. Duration curves of daily flow by months (July through October) for Genesee River at Scio, N. Y., for the period 1917-59.

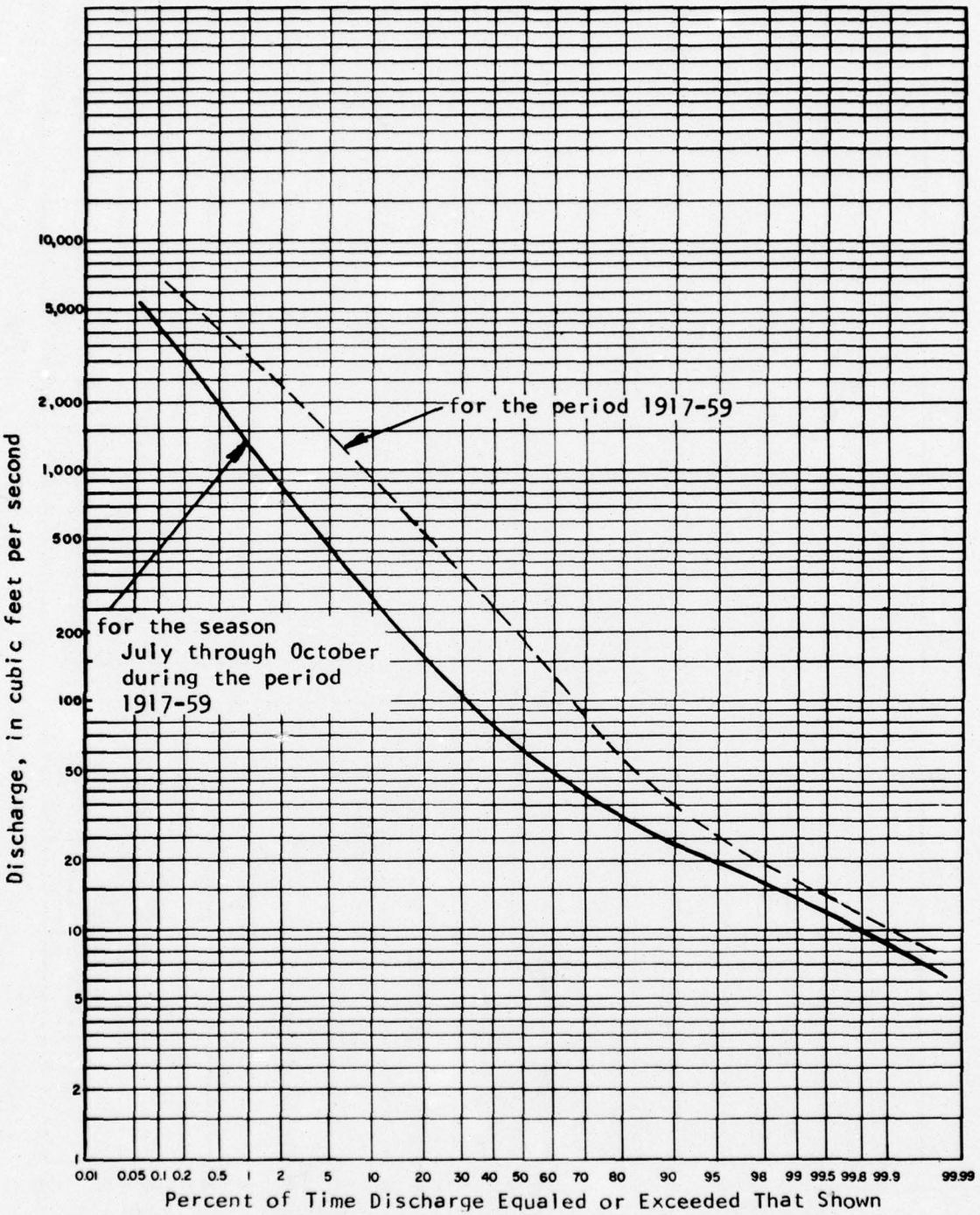

Figure 7. Duration curves of daily flow for the period 1917-59, and for the season July-October during the same period, for Genesee River at Scio, N. Y.

curve rather than the other. These, and the curves for other stations, indicate that the median discharges that occur from July through October range from about one-half to one-seventh of the median discharges for all months during the same period.

Similar seasonal and monthly duration curves of daily flows for the following stations are included in section II of the appendix:

Dyke Creek at Wellsville, N. Y.
Genesee River at Portageville, N. Y. 1/
Canaseraga Creek near Dansville, N. Y.
Genesee River at Jones Bridge, near Mt. Morris, N. Y.
Honeoye Creek at Honeoye Falls, N. Y.
Oatka Creek at Garbutt, N. Y.
Black Creek at Churchville, N. Y.

1/ Two sets of curves have been shown for this site to give a comparison of monthly and seasonal curves for long (1909-50) and short (1946-58) periods.

Duration Hydrographs

Another useful method of data presentation is the "experience" or duration hydrograph as shown in figure 8. The lines in this figure join a plotting of discrete daily discharges and should not be taken to represent continuity of flow. Thus, the bands of discrete points show different discharges for each day of the year over a specified period of record (in the case of Genesee River at Scio, the 29-year period beginning October 1930). The "low" band shows the lowest discharges that have occurred on each particular day throughout that period; the "high" band shows the highest discharges. In between, other bands show the discharges which were equaled or exceeded 20, 50 and 80 percent of the time for each day.

It should be clearly noted that the duration hydrograph shows the range of discharges experienced on a given day and does not indicate any chronological continuity. Because daily flows are sequentially correlated, the duration hydrograph cannot be used to predict streamflow.

In addition to the duration hydrograph for Genesee River at Scio, similar graphs are shown in the appendix, section III, for the following stations:

Genesee River at Portageville, N. Y.
Canaseraga Creek near Dansville, N. Y.
Genesee River at Jones Bridge, near Mt. Morris, N. Y.
Genesee River at Driving Park Ave., Rochester, N. Y.

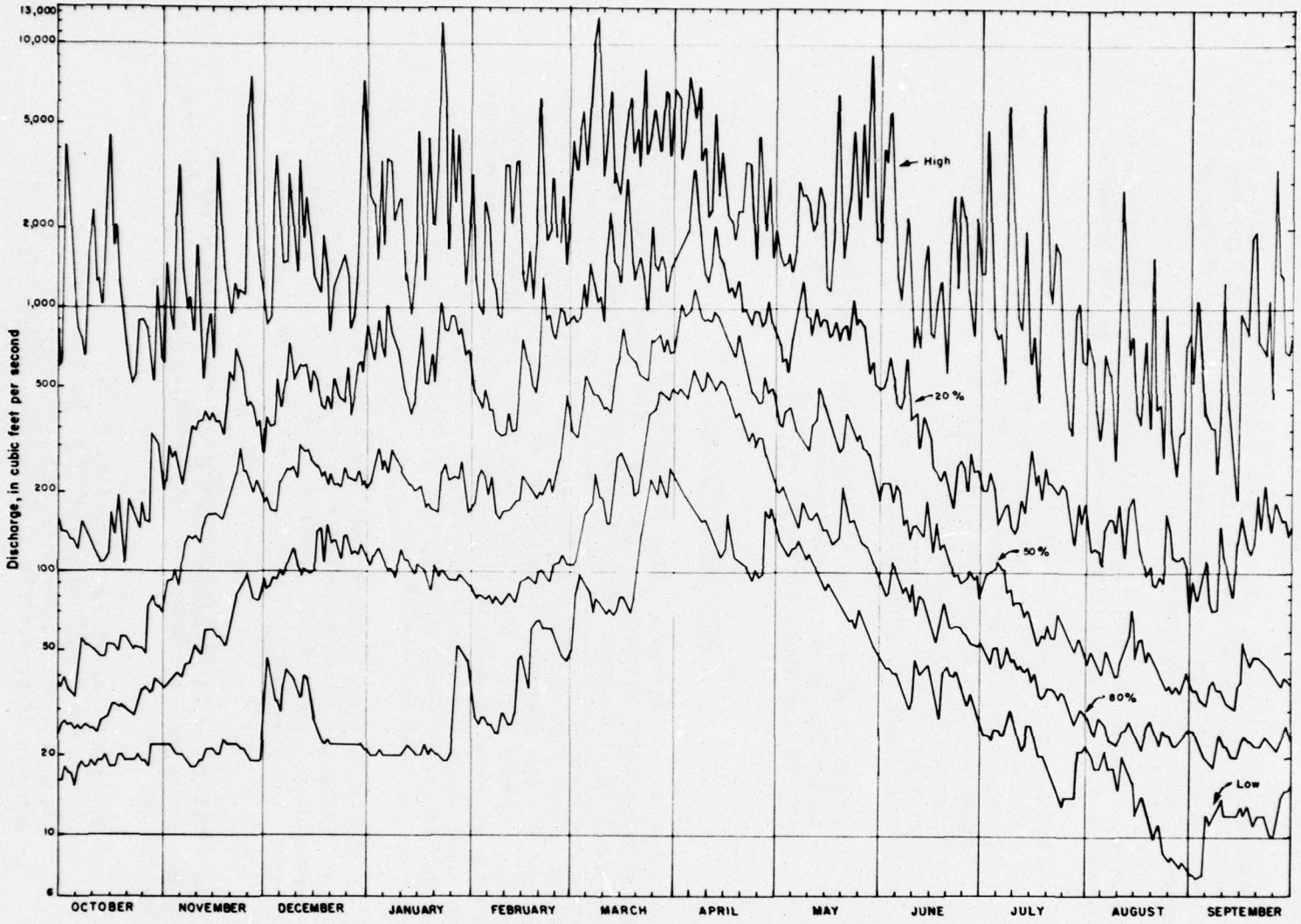

Figure 8. Duration hydrograph for Genesee River at Scio, N. Y., for the 29-year period beginning October 1930.

ANALYSIS OF LOW FLOWS

Minimum daily flows that occur each year vary considerably from stream to stream because of geology, minor diversions and regulation, and the effect of summer showers. Figure 9 illustrates this tendency which also is reflected in the fluctuations of the lower ends of duration curves.

As the result of diversion from the New York State Barge Canal System, the plot for Genesee River at Driving Park Ave., Rochester, indicates minimum flows 2 to 3 times those which might be expected on the basis of drainage area alone. Most of the very low discharges occurred either when a power plant was shut down between the gage and the canal or during the non-navigation season when no flow was diverted from the canal.

Figure 9 also shows that some minimum daily discharges on the Genesee River at Jones Bridge, near Mt. Morris, are lower than those on the Genesee River at Portageville about 25 miles upstream. This is probably the result of operation of a small hydro station between the dam and the Jones Bridge gage. At times of low flow this station is sometimes shut down completely to allow its small power-pool to refill, thus creating an artificially low flow downstream.

The low flows for Oatka Creek at Garbutt are much greater and far less variable than at many other sites because of the large and steady contribution of water to Oatka Creek from springs between Caledonia and Mumford through Spring Creek. In contrast, Honeoye Creek at Honeoye Falls has abnormally low minimum daily discharges partly as the result of diversion from Canadice and Hemlock Lakes for water supply but mostly because of the infiltration of stream water into the porous limestone that forms the bed of the creek in some reaches.

Figure 10 shows minimum flows as recorded at 11 long-term gaging stations in the Genesee River basin for periods ranging from 1 to over 200 consecutive days. These curves show the flow available without storage for various lengths of time at each site, and have been included to show differences of flow among stations.

Data for these figures were obtained from computer analyses in which summaries for low flows show the lowest mean daily discharges that have occurred during each climatic year (April to March) for designated numbers of consecutive days (1, 7, 14, 30, 60, 90, 120, 150, 183, 274). Figure 10 indicates that for Genesee River at Scio, N. Y., during the period 1917-59, the minimum mean daily flow for 30 consecutive days was 0.033 cfs per square mile. This is a flow which, on the basis of low-flow frequency studies (see next section), is expected to be equaled or exceeded at intervals averaging 40-50 years.

These curves give no indication of when during the year any

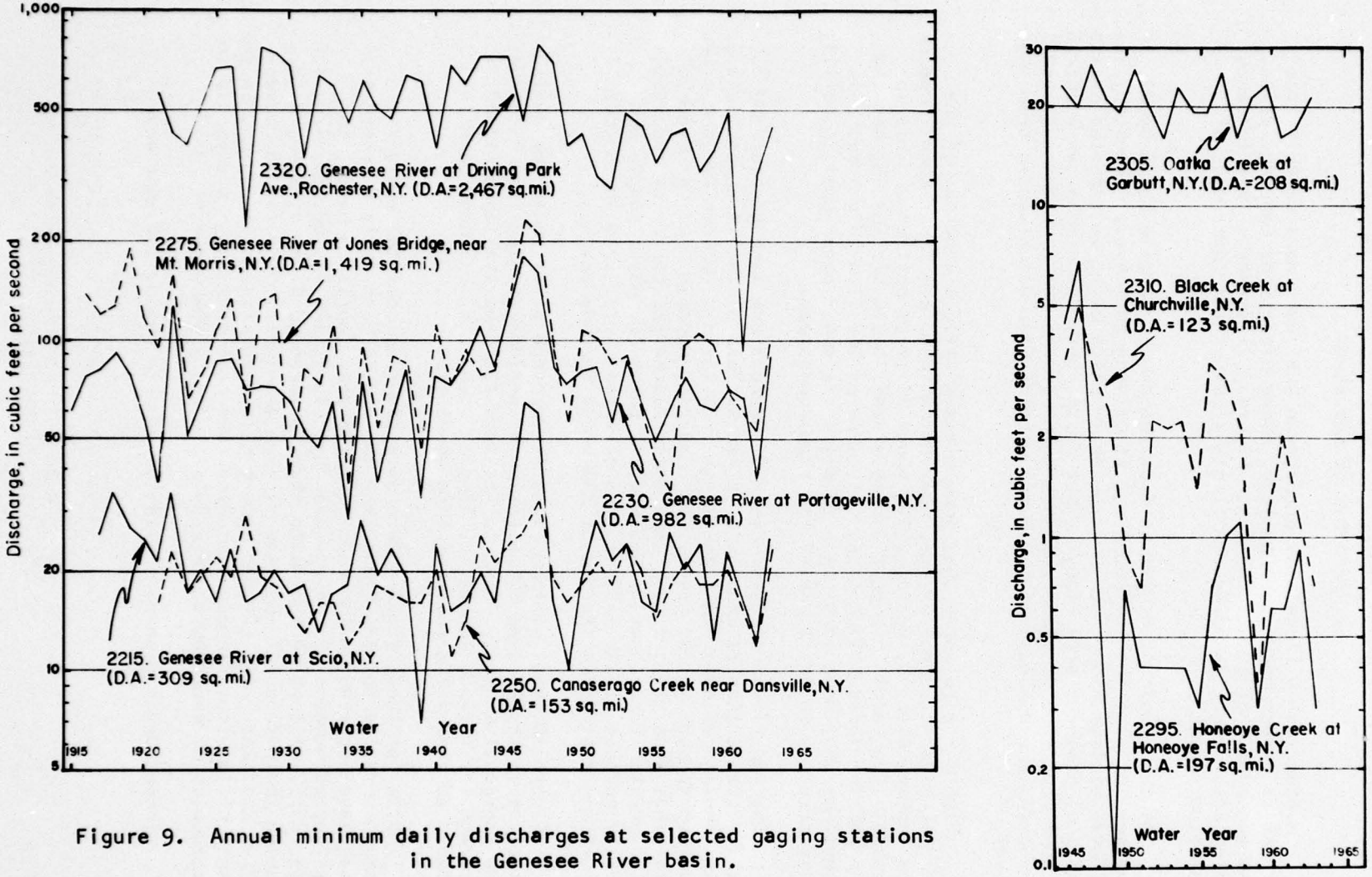

Figure 9. Annual minimum daily discharges at selected gaging stations in the Genesee River basin.

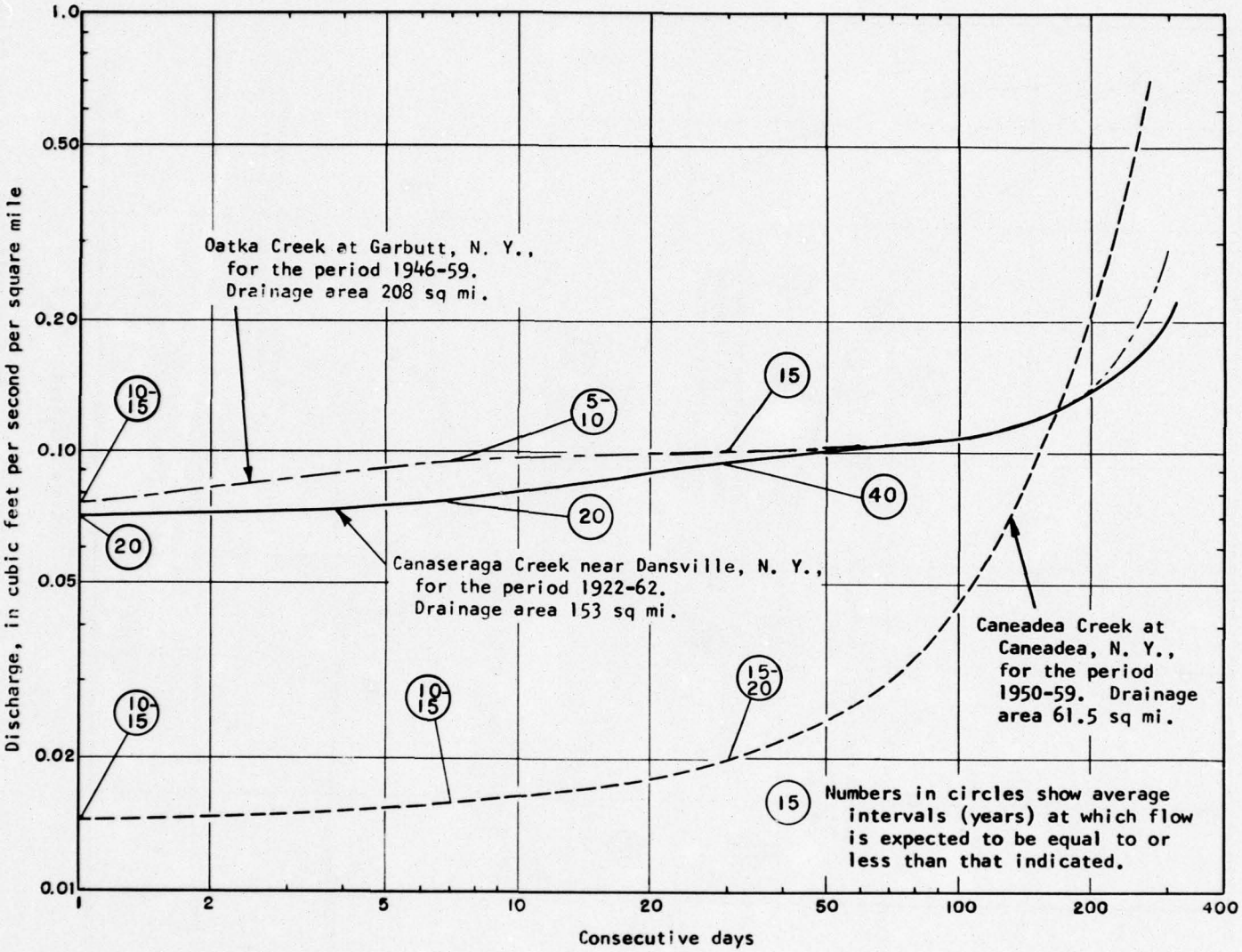

Figure 10. Minimum mean daily discharges for selected gaging stations in the Genesee River basin for number of consecutive days indicated (continued).

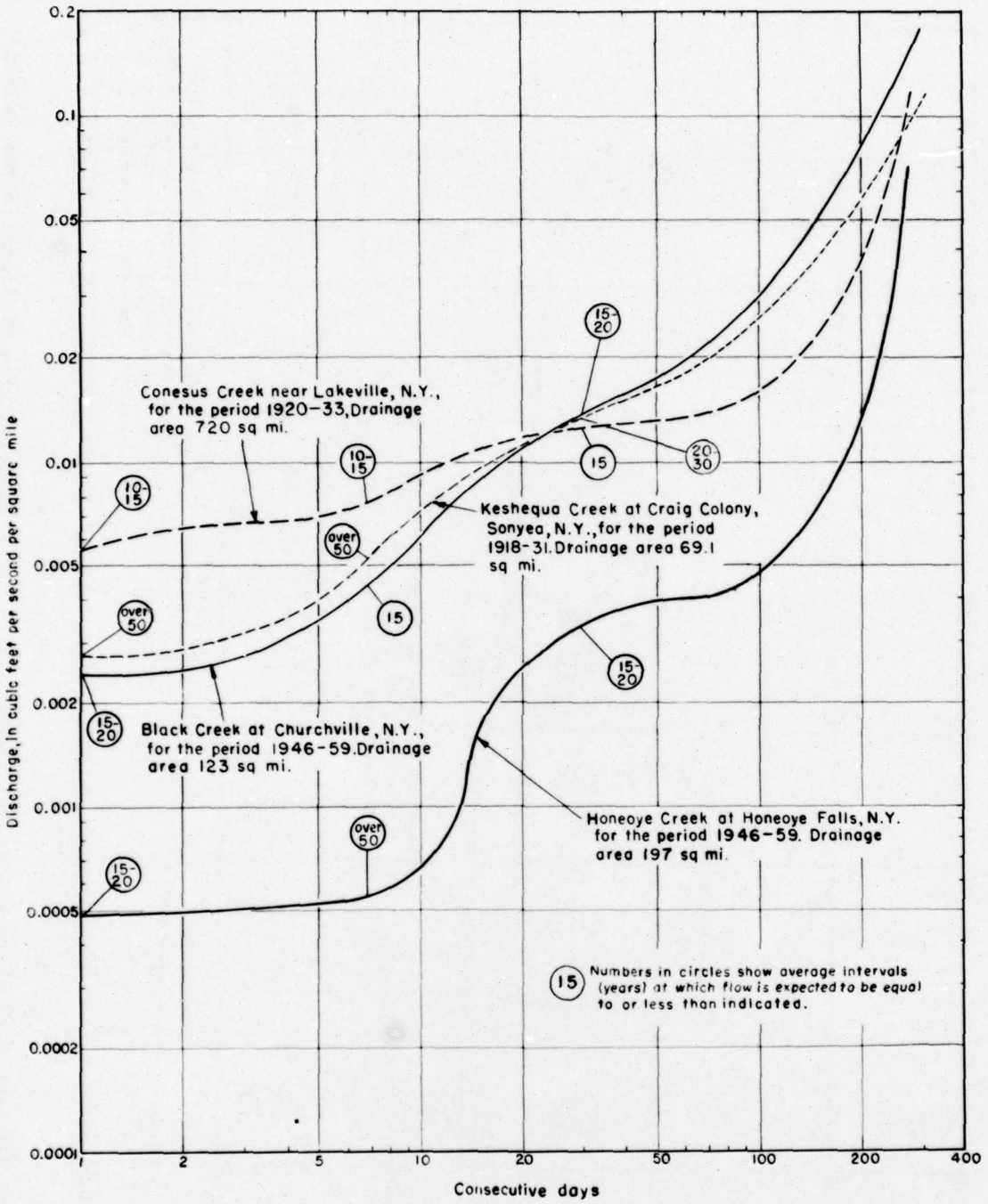

Figure 10. Minimum mean daily discharges for selected gaging stations in the Genesee River basin for number of consecutive days indicated (continued).

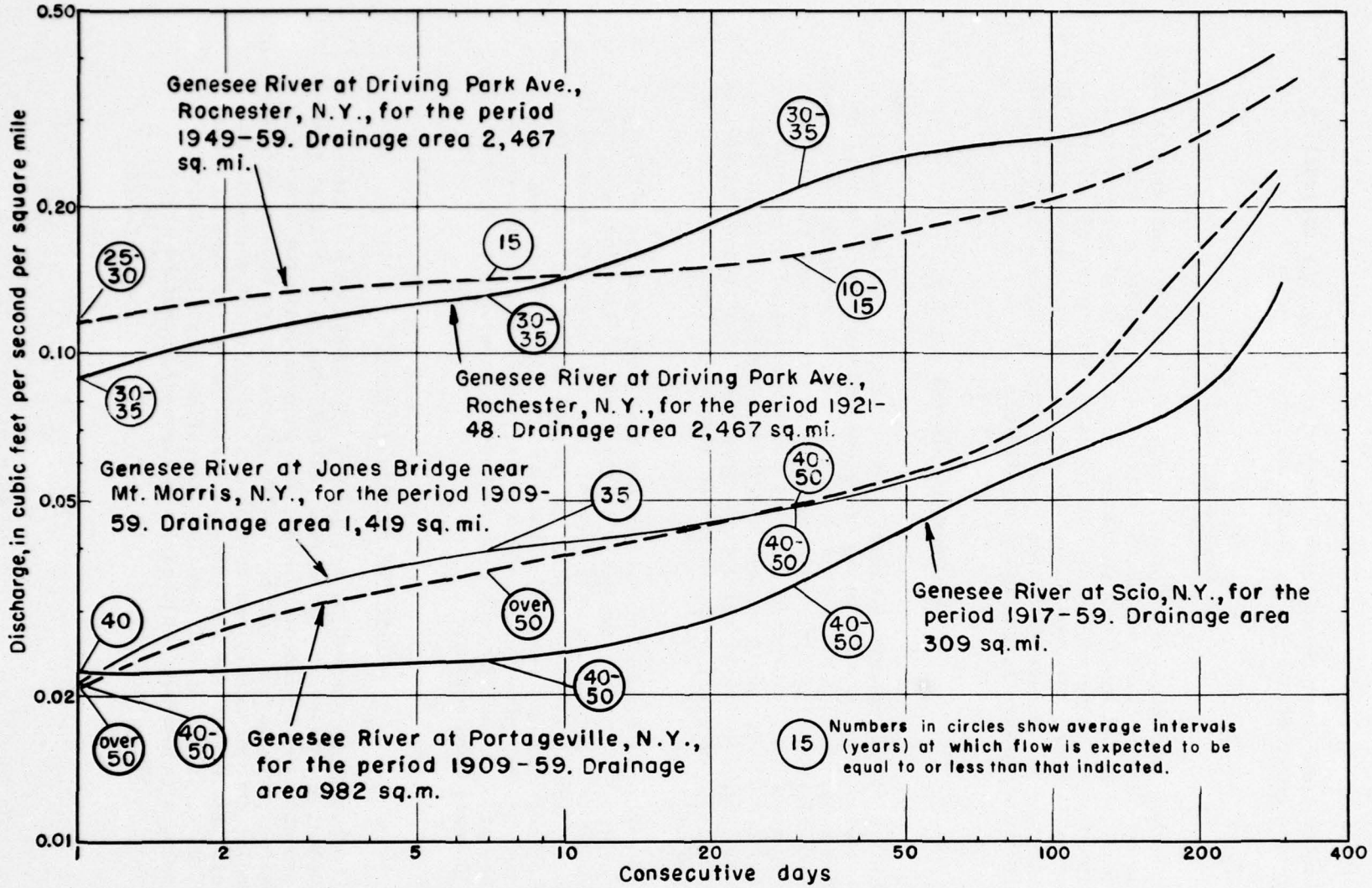

Figure 10. Minimum mean daily discharges for selected gaging stations in the Genesee River basin for number of consecutive days indicated.

particular flow might be expected. An indication of the variability of minimum daily discharges by months is shown in table 3.

Frequency Studies

Another tool available for the study of a stream's behavior is the frequency curve. Basic data used in frequency analyses are summaries of annual high and low flows processed in tabular form by computer as explained above. The return period (or recurrence interval) of any discharge for each selected number of consecutive days may be computed by assigning all annual discharge figures a rank number, starting with the lowest as number 1, and using the formula

$$\text{Recurrence interval} = \frac{n + 1}{m}$$

in which n is the number of annual events and m is the rank number. Using these data, curves showing magnitude and recurrence inteval of low flows may be plotted as in figure 11. Similar analyses can be made for high flows. Figure 11 indicates that on the average the minimum mean 30-day flow for Genesee River at Scio is expected to be equal to or less than 20 cfs at intervals averaging 10 years in length; the minimum 7-day flow to be equal to or less than 15 cfs, and the minimum 1-day flow to be equal to or less than 14 cfs for the same recurrence interval.

Low-flow frequency information has been developed for all long-term gaging stations in the basin on the basis of existing records. Flow data were correlated with records from the long-term stations in order to provide similar information for new gaging stations, partial-record stations, and selected miscellaneous sites. These data are included in the appendix, section 1. The tables show discharges for periods of 1, 7, and 30 days with recurrence intervals of 2, 5, 10, 20, and 30 years when possible.

Base-flow Recession Curves

Forecasts of streamflow are growing in importance as water-management increases in complexity. Because the most critical times are probably those without rainfall for long periods, the base-flow recession curve may be used to provide the necessary advance notice of impending drought conditions to allow for planning of emergency or remedial measures. The base-flow recession curve for Genesee River at Scio, N. Y. is shown in figure 12. Base-flow recession curves for the following stations are included in the appendix, section IV:

Table 3.--Minimum daily discharges by months for selected gaging stations in the Genesee River basin.

(discharges in cfs)

	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.
2215. Genesee River at Scio, N. Y. (Period 1917-64)	15	18	17	19	16	50	92	48	26	13	7.2	6.9
2220. Caneadea Creek at Caneadea, N. Y. (Period 1950-64)	1.0	.9	1.2	1.1	.8	1.0	1.8	1.7	1.4	1.1	1.3	1.2
2230. Genesee River at Portageville, N. Y. (Period 1909-64)	20	63	76	72	66	160	317	140	76	28	32	28
2250. Canaseraga Creek near Dansville, N. Y. (Period 1910-12, 1915-16, 1917-19, 1920-64)	14	15	15	13	15	24	43	23	17	12	12	11
2260. Keshequa Creek at Craig Colony, Sonyea, N. Y. (Period 1918-32)	1.3	2.5	1.0	1.0	1.0	2.0	6.2	7.2	2.1	1.2	.2	.1
2275. Genesee River at Jones Bridge, near Mount Morris, N. Y. (Period 1909-64)	40	60	100	106	88	220	460	223	106	36	30	38
2280. Conesus Creek near Lakeville, N. Y. (Period 1919-34)	1.0	.6	.4	.6	.6	10	50	25	2.6	1.0	.7	.8
2295. Honeoye Creek at Honeoye Falls, N. Y. (Period 1945-64)	.2	.9	1.0	1.1	.9	11	36	25	2.0	.4	.1	.2
2305. Oatka Creek at Garbutt, N. Y. (Period 1945-64)	19	16	16	16	18	38	88	56	35	28	22	17
2310. Black Creek at Churchville, N. Y. (Period 1945-64)	.7	3.8	3.9	3.6	2.8	19	41	12	2.1	.7	.3	.5
2320. Genesee River at Driving Park Ave., Rochester, N. Y. (Period 1920-64)	286	421	100	91	91	476	389	788	375	340	219	357

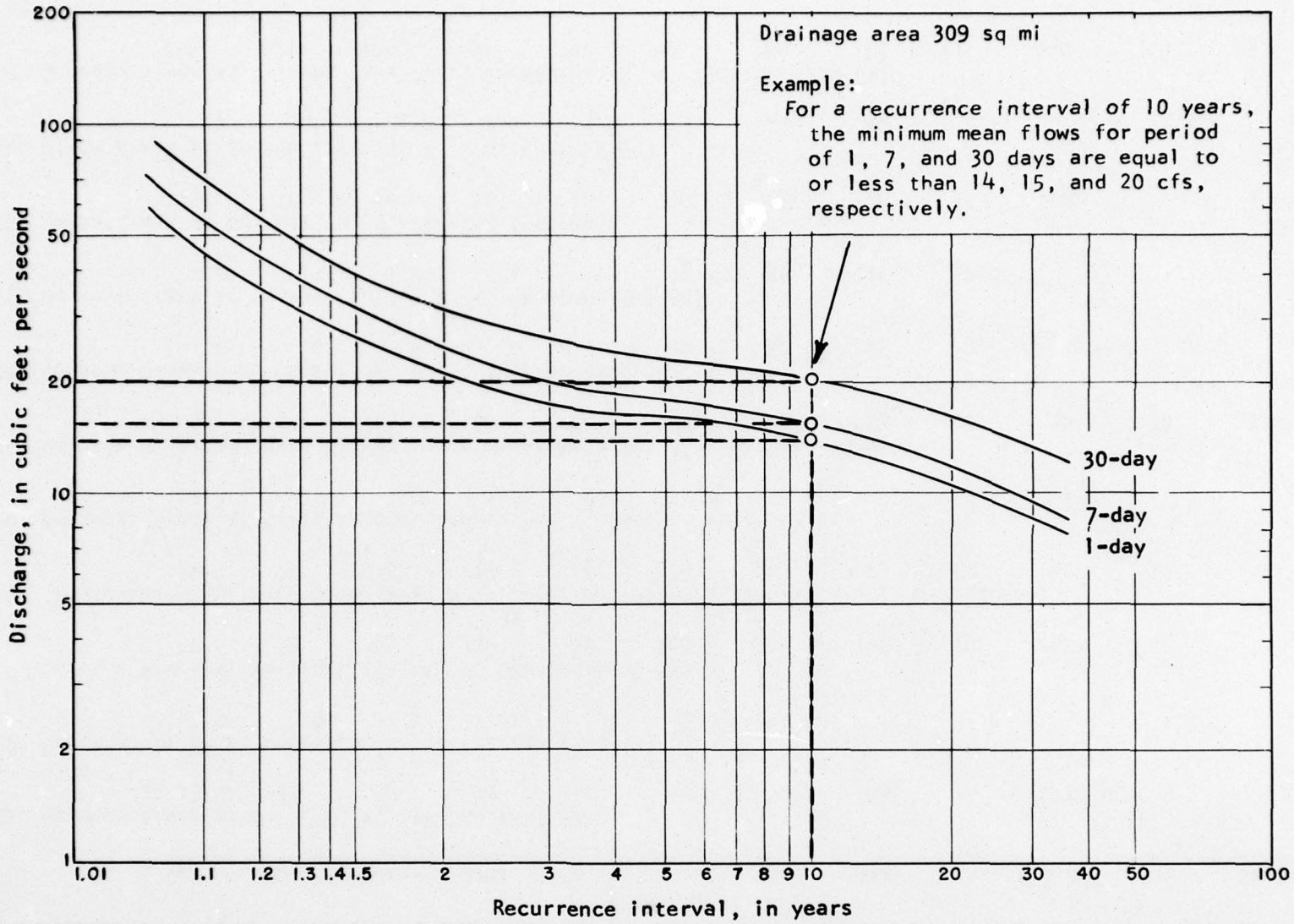

Figure 11. Low-flow frequency curves for Genesee River at Scio, N. Y., for the period 1917-59.

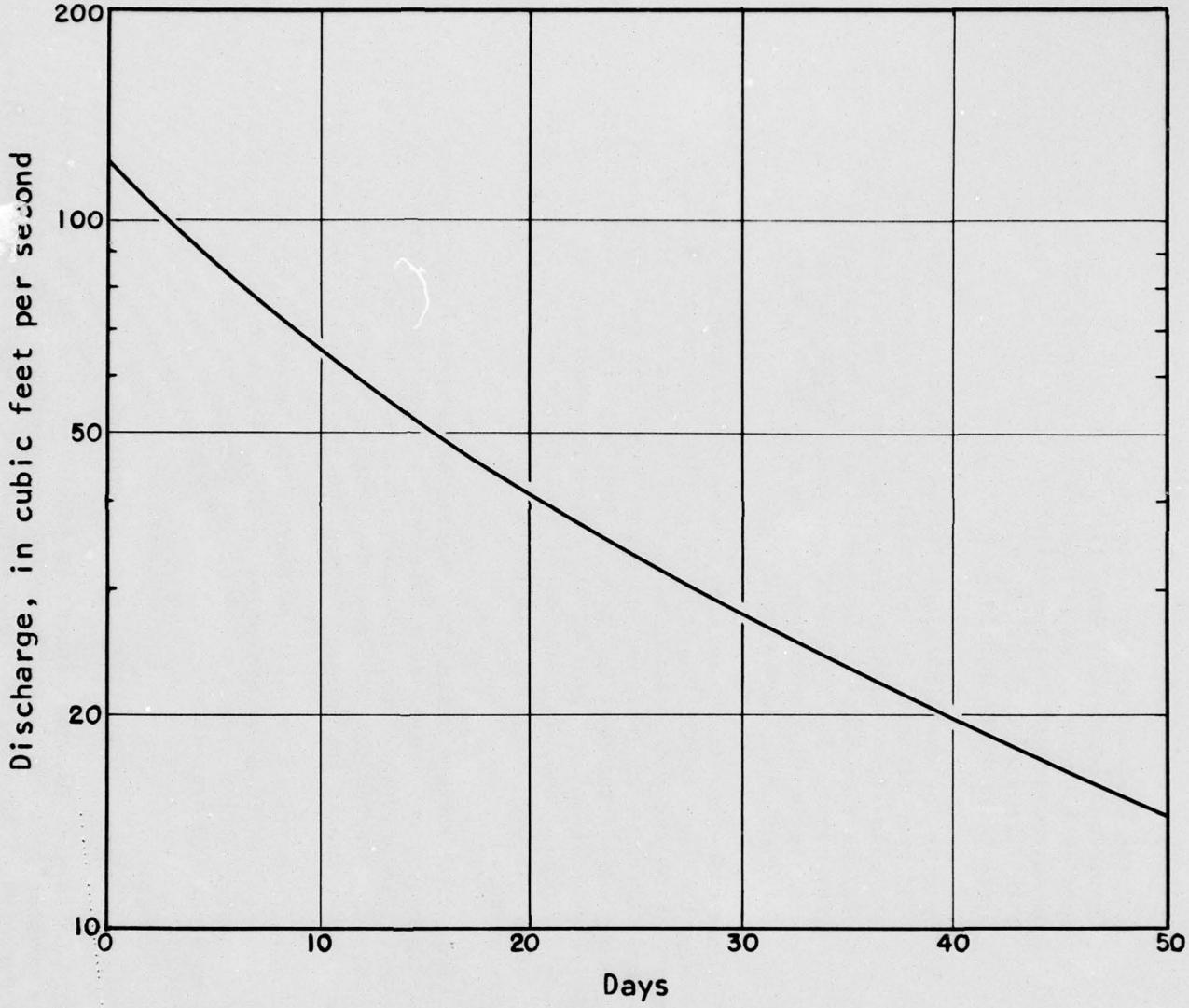

Figure 12. Base-flow recession curve for the period May to October, Genesee River at Scio, N. Y.

Genesee River at Portageville, N. Y. 1/
Canaseraga Creek near Dansville, N. Y.
Genesee River at Jones Bridge near Mt. Morris, N. Y. 1/
Honeoye Creek at Honeoye Falls, N. Y. 1/
Oatka Creek at Garbutt, N. Y.
Black Creek at Churchville, N. Y. 1/

1/ Records for these stations indicate that flows are or have been affected by regulation to some extent. Thus, the base-flow recession curves must be used with caution because they have not been adjusted for regulation in many cases. See "Remarks" paragraph of gaging-station descriptions in the appendix, section 1, for more information on such regulation.

These base-flow recession curves were constructed in a manner described by Riggs (1963) from the streamflow hydrographs for each station. From the hydrographs, periods of 10 days in length were selected during which there was no significant rain and which began long enough after the previous peak so that base-flow conditions were presumably in effect. A plot of the base-flow discharge at the end of the 10-day period against the base-flow discharge at the beginning of the period was made and then interpreted to synthesize the base-flow recession curve.

Base flow differs seasonally because of changes in evapotranspiration rates, soil-moisture conditions, precipitation, temperature, snowmelt, stream freeze-ups, and other factors. The period May through October was selected for this analysis because in the Genesee River basin it represents the growing season and the season of low streamflow.

Data from figure 12 indicate that if the Genesee River at Scio is discharging 120 cfs under base-flow conditions and there is no rainfall, the discharge will decrease to 66 cfs at the end of the next 10 days, and to 41 cfs 10 days later.

Intermittent and Influent Streams

A basin-wide reconnaissance was made when flows at gaged streams were generally in the 95 to 99 percent range on the duration curve. The purposes of this were to make sure that all major streams were known, to collect streamflow data under as nearly constant conditions as possible for use in defining areal distribution of flow, ground-water and surface-water relationships, and to document intermittent streams (streams which have no flow at times during the year).

The identification of those stretches of streams that are dry a part of each year is of interest to many who contemplate utilizing a stream for water supply or discharge of wastes. Twenty sub-basin maps

(obtained from the U.S. Soil Conservation Service) appear in the appendix, section V, and show points where observations of no flow were made. It should be noted that the observations apply specifically to the points indicated and no assumptions can be made that because a site has no flow, sites upstream from it also have no flow. Neither can it be assumed that because a stream of a certain drainage area has no flow, other streams of equal or lesser drainage areas will have no flow as well.

This stream reconnaissance also helped to indicate the existence of influent conditions, that is, streams in which the flow in certain upstream reaches is greater than that found at a downstream location. Meinzer (1923, p. 56) more exactly describes such a situation as follows: "A stream or stretch of a stream is influent with respect to ground water if it contributes water to the zone of saturation. The upper surface of such a stream stands higher than the water table or other piezometric surface of the aquifer to which it contributes." Table 4 lists known influent streams in the Genesee River basin. The reconnaissance indicated that most of the water lost by the streams was to the zone of saturation rather than to the atmosphere because of the absence of large pools, ponds, lakes, or swampy areas on the streams in the vicinity of the reach where water was lost. Another indication was that most of the streams gained flow again at some location downstream from the losing reach. Doubtless, these influent conditions are not necessarily persistent; that is, a stream may lose water at one time of the year and gain at another time in the same reach.

Clearly, studies of streams during periods of low flow must be carefully done to prevent discounting a stream as a water source because of the discovery of an influent reach first and then investigating no further. Table 4 indicates that when Rush Creek at Fillmore, N. Y. is dry, there probably is at least 0.4 cfs flowing in the upstream reaches. Even influent reaches may be developed for use through the installation of wells which can withdraw water from the valley bottom.

Table 4.--Influent streams in the Genesee River basin.

STREAMGAGING SITE	DRAINAGE AREA (sq mi)	DATE	DISCHARGE (cfs)	REMARKS (All distances refer to site listed in first column)
Chenunda Creek at Stannards Corners, N.Y. 2204.3	about 30	7/23/64	0.9	At bridge on State Highway 19, 0.8 mile downstream: creek dry.
Dyke Creek near West Greenwood, N.Y. 2204.5	1.64	7/20/64	.1	At bridge on State Highway 21, 3.6 miles downstream: creek dry. At gaging station, Dyke Creek near Andover, 5.1 miles downstream: discharge, 2.2 cfs. At partial-record station, Dyke Creek at Wellsville, 11.8 miles downstream: discharge, 2.5 cfs.
Marsh Creek Tributary near Andover, N.Y. 2204.6	1.59	10/21/64	.03	Creek dry at least 500 ft, both upstream and downstream.
Elm Valley Creek near Elm Valley, N.Y. 2204.8	4.75	9/10/64	.07	About 100 ft downstream: creek dry. At bridge 1.5 miles downstream: creek dry. At bridge 2.0 miles downstream: discharge estimated, 0.1-0.2 cfs. At bridge 2.6 miles downstream: creek dry. At bridge 3.1 miles downstream on State Highway 17: creek dry.
Vandermark Creek near Scio, N.Y. 2215.1	about 22	7/7/64	.5	At bridge on State Highway 19, 1.2 miles downstream: few puddles but no detectable flow.
Phillips Creek near Belmont, N.Y. 2215.6	about 20	7/23/64	1.0-1.5 (estimated)	At bridge 1.4 miles downstream: creek dry upstream for at least 500 ft, few puddles downstream.
White Creek near Belfast, N.Y. 2217.6	about 14	9/4/64	.3	At bridge on State Highway 19, 1.0 mile downstream: creek dry.
Wigwam Creek at Belfast, N.Y. 2218.1	about 11	7/29/64	.2	Creek dry just downstream from bridge at gaging site.
Crawford Creek at Oramel, N.Y. 2218.3	about 10	8/7/64	.4	At bridge on State Highway 19, 1.1 miles downstream: creek dry.
Rush Creek near Fillmore, N.Y. 2225.35	about 35	8/6/65	.4	At bridge 1.6 miles downstream: creek dry.
Ewart Creek at Swain, N.Y. 2245.5	3.90	9/16/64	0	At next bridge about 0.5 mile upstream: estimated discharge, 0.1-.3 cfs.
Sugar Creek near near Ossian, N.Y. 2247	9.83	9/16/64	.2	At bridge 1.0 mile downstream: creek dry.
Keshequa Creek at Craig Colony, Sonyea, N.Y. 2260	69.1	6/24/65	3.6	At Nunda Junction about 7 miles upstream: discharge estimated about 6 cfs.
Beards Creek at Cuylerville, N.Y. 2276	about 49	10/22/64	0	Estimated total discharge in several tributaries upstream, about 0.1-0.2 cfs.
Stony Creek at Warsaw, N.Y. 2303.6	about 9	8/29/64	.4	At bridge 0.4 mile downstream: creek dry.
Oatka Creek at Warsaw, N.Y. 2303.8	42.2	6/18/65	6.5 (estimated mean daily)	At miscellaneous site, Oatka Creek near Roanoke: discharge, 12 cfs. Through a reach extending from about 2 to 4 miles downstream from village of LeRoy: creek dry. At miscellaneous site, Oatka Creek near Lime Rock: discharge, 6.3 cfs. At gaging station, Oatka Creek at Garbutt, mean daily discharge about 45 cfs.

Note: All discharges listed are results of discharge measurements unless designated otherwise.

DISTRIBUTION OF FLOWS

The variability of streamflow in the basin, with both time and location, is shown in figure 13. The graphs in figure 13 show the normal pattern of highs for the year in March and April, and lows in September and October. However, for the stations on the Genesee River and Canaseraga Creek, runoff for January is higher than that for February while the opposite is true for the other stations. This and other minor variations are probably caused by a combination of differences in climatic conditions, topography, size of drainage area, and other factors.

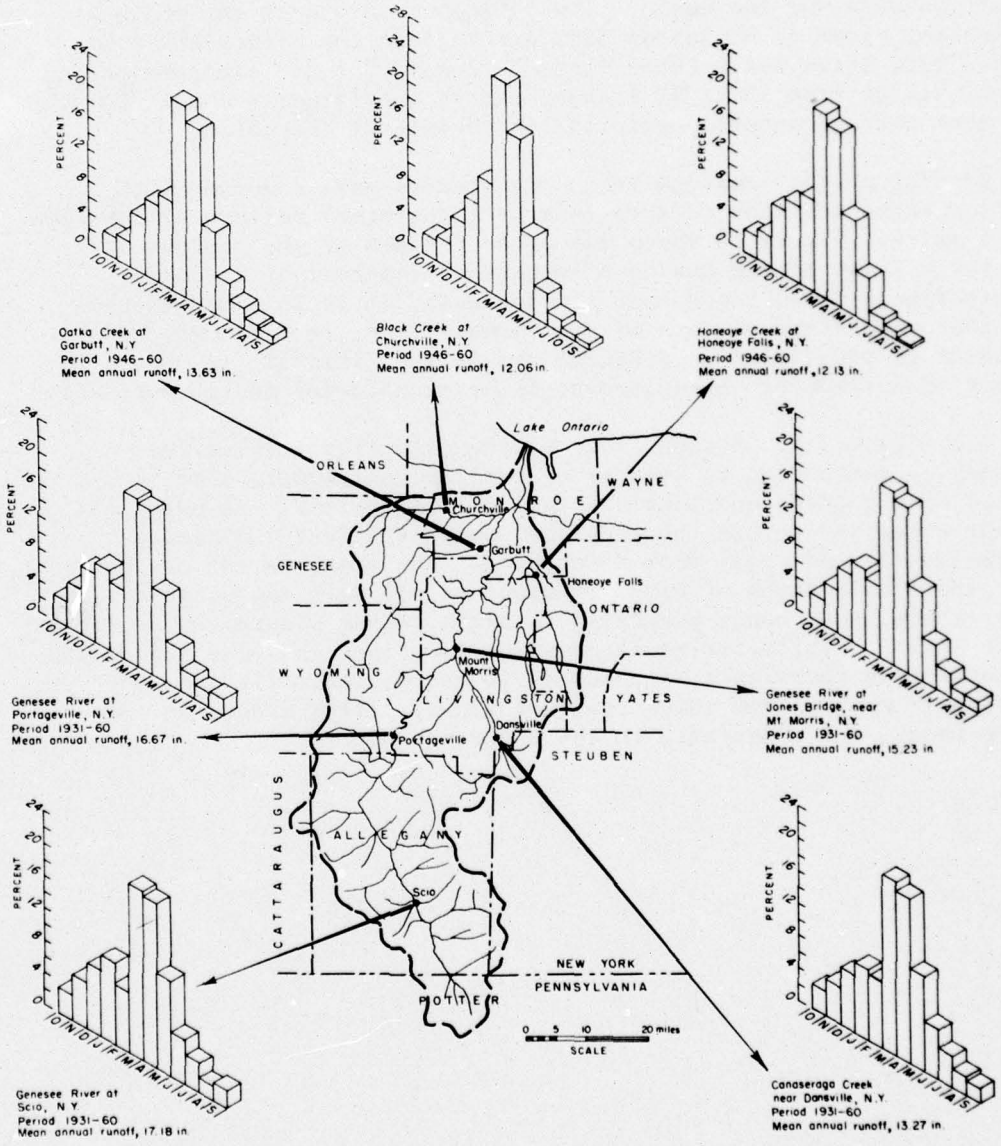

Figure 13. Average monthly distribution of runoff for selected gaging stations in the Genesee River basin.

In general, runoff on a yearly basis, as seen in figure 14, follows a consistent pattern throughout the basin with the periods of high runoff and low runoff occurring in the same years at the different stations. In figure 14 the range from 80 to 120 percent is lightly shaded to indicate near-normal runoff; darker shading outside this range indicates years of deficient or excessive runoff.

The areal pattern of average annual runoff for the basin is shown in figure 15. The isopleths of runoff are based upon all available streamflow data for the basin. The 14-inch isopleth at the mouth of the Genesee River at Rochester does not include the diversions from the New York State Barge Canal System. Runoff for the standard period 1931-60 varies from 10 to 20 inches, and is consistently about 20 inches less than average annual precipitation throughout the basin.

Results of the low-flow frequency studies were combined with low-flow reconnaissance data to interpret the areal pattern of low flow in the basin. Figure 16 shows the areal pattern of the average low flow for a 7-day period having a recurrence interval of 2 years. Because figure 16 is based upon limited data, it is intended to show only the generalized pattern of low flows. Minor revision may be indicated as additional data become available. This figure should not be used to extrapolate or interpret low-flow data for design purposes.

The flow of the Genesee River as shown in figure 16 varies noticeably, responding to greater or smaller contributions of flow from adjoining areas and possible influent conditions. However, all discharges at the points representing gaging stations indicate an increasing rate of total flow downstream. The areal extent of the lower and middle range of flows is about equal, with the areas of low flows in the upper range occurring in eight rather widespread sections of the basin. Similar trial studies for low flows in 7-day and 30-day periods with a recurrence interval of 10 years, generally show an increase in area in the lower range of flows, little change in the middle range, and a decrease in the upper range.

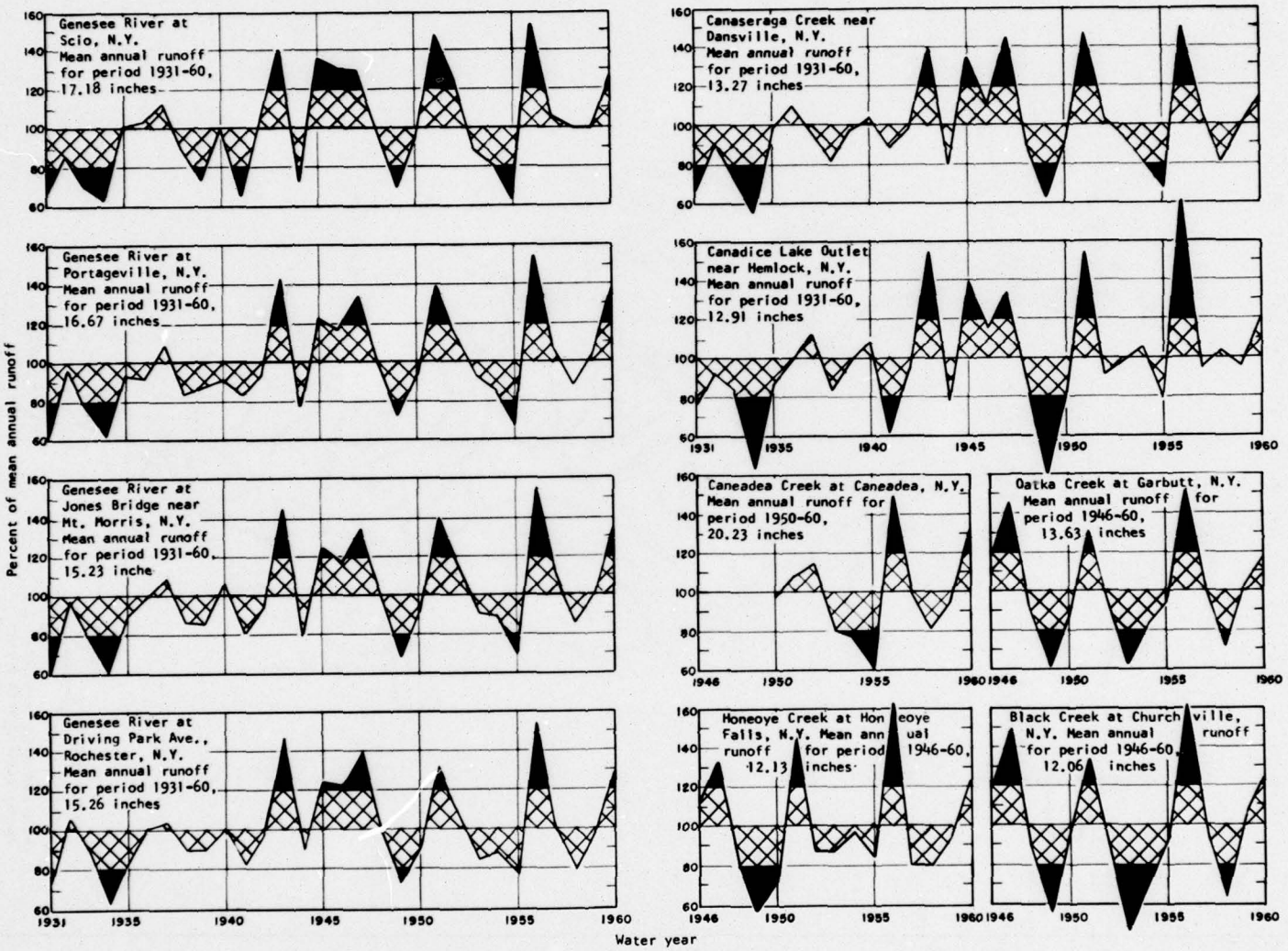

Figure 14. Yearly variations of runoff for selected gaging stations in the Genesee River basin.

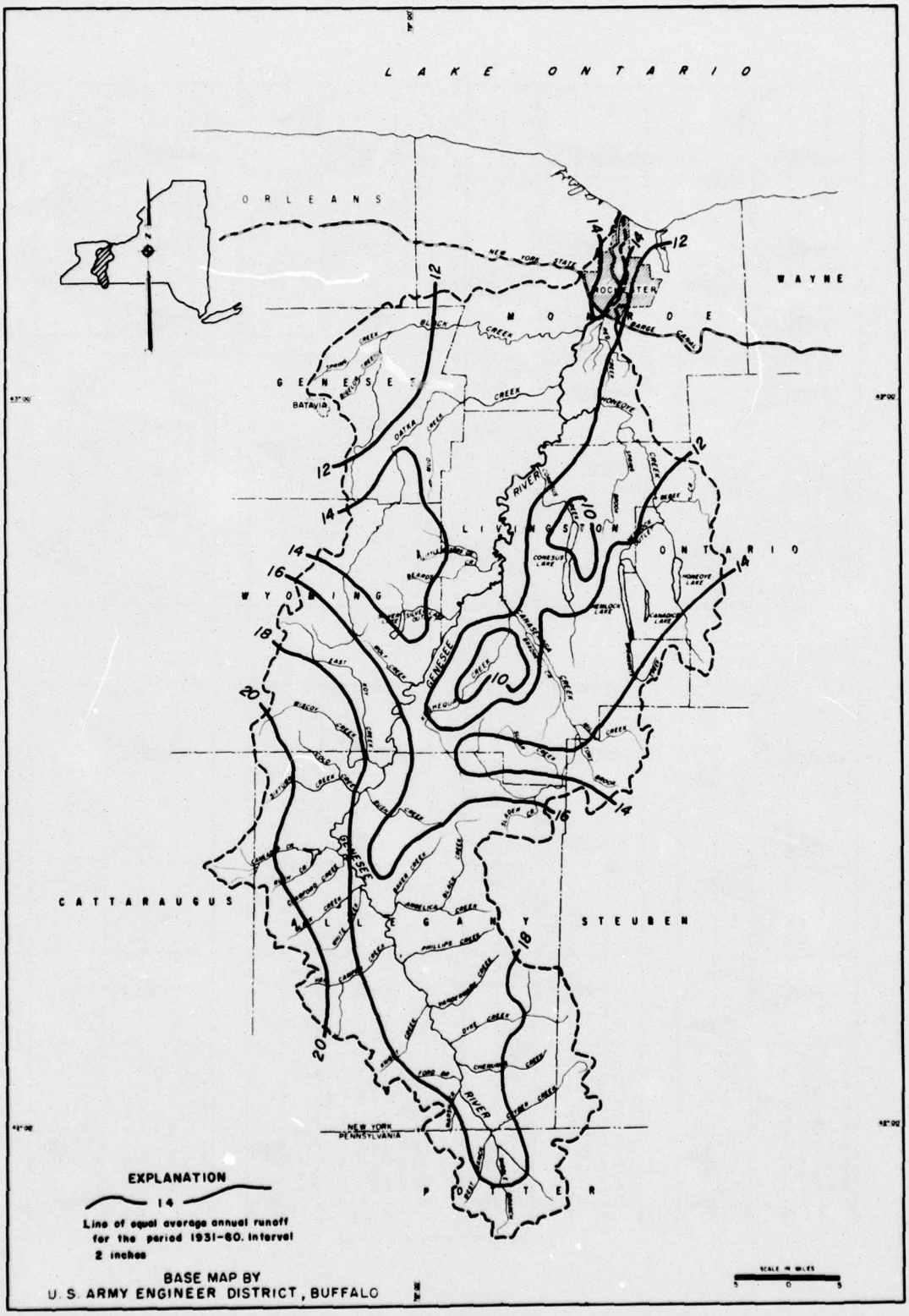

Figure 15. Map of average annual runoff in the Genesee River basin.

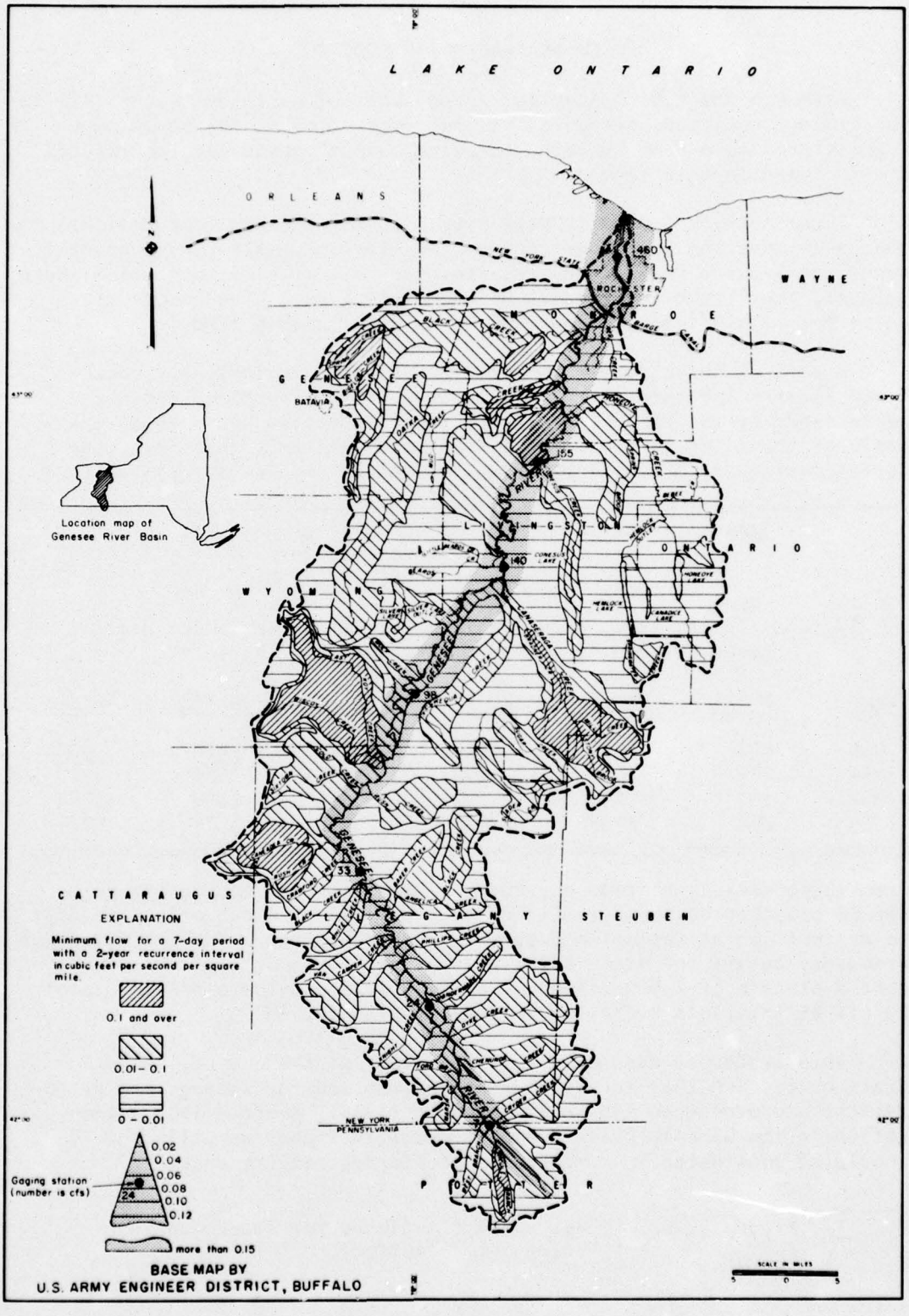

Figure 16. Generalized distribution of low flow in the Genesee River basin.

FLOW AVAILABLE FOR STORAGE

Although the U.S. Geological Survey was not assigned responsibility for storage analyses, suitable data for gage sites in the basin were readily available from standard computer output sheets and, therefore, are included in this section.

Three methods generally have been used for storage computations: the mass-curve for period of record; the frequency mass-curve; and the annual mass-curve for within-year storage. Riggs [1/] has evaluated these methods, their relative advantages and limitations. The annual mass-curve for within-year storage method was used in this study.

A part of the computer computation is shown in table 5. Underlined figures indicate that the tabulated storage required was not replenished by the following April 1 (these analyses are made on the basis of the climatic year, April 1 to March 30) and, therefore, the corresponding draft could not be maintained by within-year storage.

Table 5.--Partial output of computer program for within-year storage for Black Creek at Churchville, N. Y.

Storage, in cfs-days, required to maintain the following draft rates during the climatic year beginning April 1.

Year	10 cfs	15 cfs	20 cfs	25 cfs	30 cfs	40 cfs
1960	853	1978	3126	4290	5474	7903
1961	224	603	1044	1756	2684	4717
1962	197	634	1094	1559	2038	3284
1963	824	1598	2431	3427	4511	6771

From these tables, a frequency curve of storages for each draft rate can be prepared as shown in figure 17. Curves are shown only for draft rates that can be replenished by within-year storage. The draft-storage frequency curves for Black Creek at Churchville indicate, for example, that a storage of 2,600 cfs-days would fail to provide a draft rate of 20 cfs at intervals averaging 10 years in length.

This procedure assumes a full reservoir at the outset, uniform draft rates, and that the storage is uncorrected for seepage and evaporation. According to Knox and Nordenson (1955), average lake evaporation in the Genesee River basin is about 24 inches annually and should be considered in computation of storage requirements.

1/ Riggs, H. C., 1964, "Storage Analyses for Water Supply" (written communication).

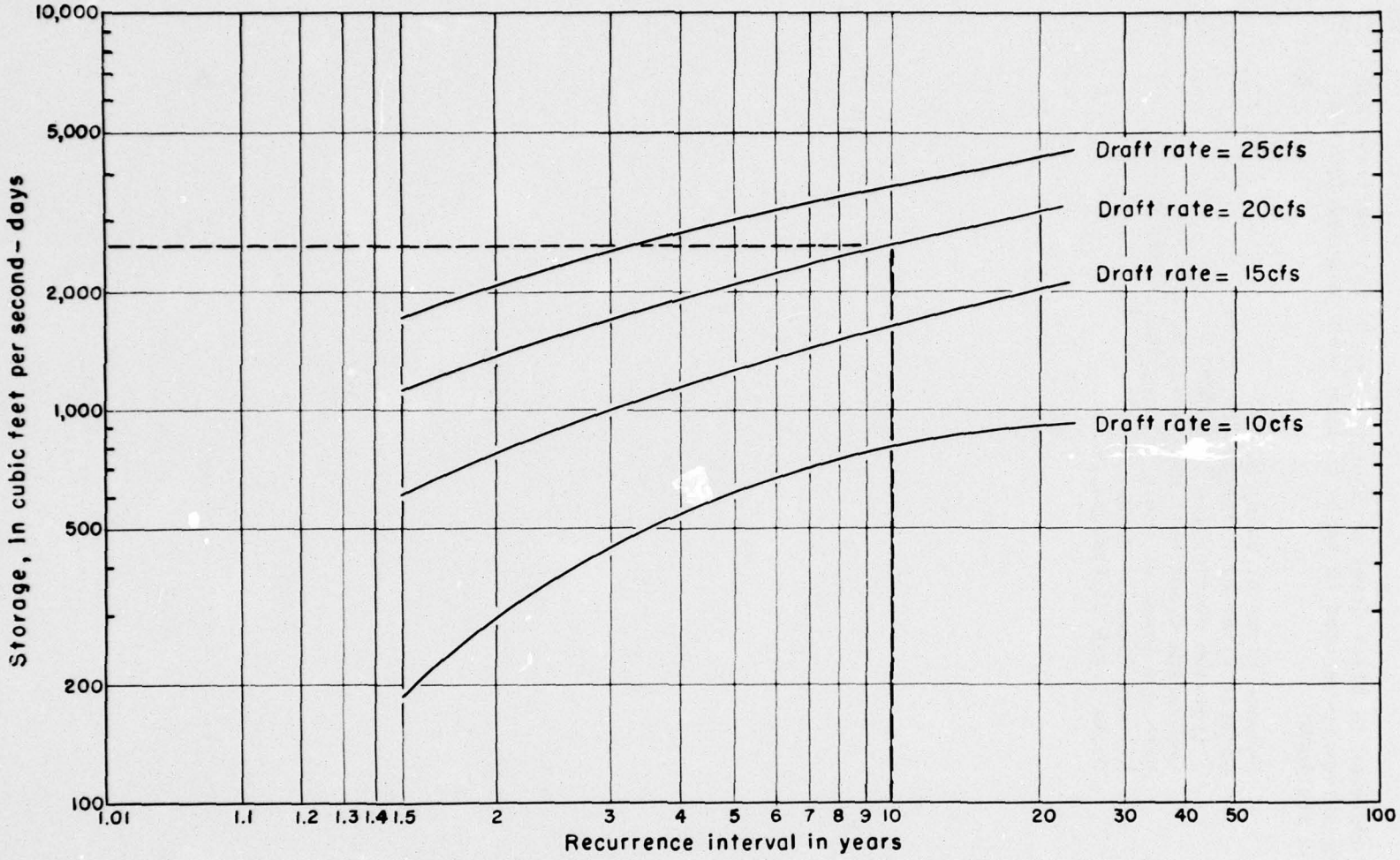

Figure 17. Draft-storage frequency curves for Black Creek at Churchville, N. Y., for the period 1946-63.

In addition to Black Creek at Churchville, N. Y., draft-storage frequency curves summarized in table 6, have been computed for the following stations:

Genesee River at Scio, N. Y.
Genesee River at Portageville, N. Y.
(for two overlapping periods)
Canaseraga Creek near Dansville, N. Y.
Keshequa Creek at Craig Colony, Sonyea, N. Y.
Honeoye Creek at Honeoye Falls, N. Y.
Oatka Creek at Garbutt, N. Y.

Table 6.--Summary of draft-storage frequency data for selected gaging stations in the Genesee River basin.

Station number	Stream and location	Period	Draft rate (cfs)	Recurrence interval (years) 2	5	10	15	20	30
				Storage required (cfs-days)					
2215.	Genesee River at Scio, N. Y.	1931-59	100	5,600	9,000	10,000	10,700	11,000	11,500
			75	3,000	5,000	6,000	6,400	6,700	7,000
			60	1,800	3,000	3,900	4,200	4,300	4,500
			50	950	2,000	2,600	2,800	2,900	3,000
2230.	Genesee River at Portageville, N. Y. ("at St. Helena", 1931-45)	1931-63	400	18,000	38,000	41,000	44,000	48,000	56,000
			300	8,000	20,000	24,000	27,000	30,000	34,000
			250	5,000	13,000	17,000	19,000	20,000	23,000
2230.	Genesee River at Portageville, N. Y.	1946-63	400	22,000	38,000	44,000	50,000	56,000	--
			300	12,000	21,000	27,000	31,000	34,000	--
			250	8,000	15,000	19,000	21,000	23,000	--
2250.	Canaseraga Creek near Dansville, N. Y.	1931-62	50	2,100	3,700	4,600	5,000	5,300	5,600
			45	1,400	2,900	3,700	4,100	4,300	4,600
			40	950	2,100	2,800	3,100	3,300	3,600
2260.	Keshequa Creek at Craig Colony, Sonyea, N. Y.	1918-31	10	470	900	1,200	1,400	1,600	--
			5	80	220	310	350	370	--
2295.	Honeoye Creek at Honeoye Falls, N. Y.	1946-63	30	3,400	4,800	5,800	6,300	6,700	--
			20	1,800	2,900	3,600	3,900	4,200	--
			15	1,200	2,000	2,400	2,700	2,800	--
			10	600	1,100	1,400	1,600	1,800	--
2305.	Oatka Creek at Garbutt, N. Y.	1946-63	60	3,600	5,400	6,500	7,000	7,200	--
			50	2,200	3,400	4,200	4,600	4,800	--
			40	1,000	1,700	2,300	2,600	2,800	--
			30	180	530	880	1,050	1,200	--
2310.	Black Creek at Churchville, N. Y.	1946-63	25	2,100	3,100	3,700	4,000	4,400	--
			20	1,400	2,100	2,600	2,900	3,200	--
			15	780	1,250	1,600	1,800	2,000	--
			10	280	620	800	870	900	--

SUMMARY AND CONCLUSIONS

As part of its responsibility in the comprehensive study of the Genesee River basin, the U.S. Geological Survey has furnished new and existing data on a continuing basis as requested by other agencies.

Data have been collected for streams and lakes in the basin for periods ranging up to 60 years. Records for the principal measurement sites have been summarized by Gilbert and Kammerer (1965) and, together with the new information collected during 1964 and 1965 form the basis for the information presented in this report. By processes of correlation, the shorter streamflow records have been extended to a standard period, 1931-60, to allow comparison among streams on an equivalent basis for duration and frequency analyses.

Studies of runoff for the standard period 1931-60 indicate average annual runoff ranges from 10 to 20 inches over the basin, producing an overall average figure of about 14 inches. Average annual runoff is consistently about 20 inches less than precipitation throughout the basin.

A generalized map was constructed to show the areal distribution of average low flows for a 7-day period having a 2-year recurrence interval. This map was based on a reconnaissance of the basin when duration of streamflow was generally between 95 and 99 percent and supplements data from the low-flow frequency analyses. During the reconnaissance, streamflow conditions ranged from no flow at many locations to almost 3.0 cfs per square mile for Spring Creek at Mumford, N. Y.

In addition to the studies mentioned above, monthly and seasonal duration curves, duration hydrographs, base-flow recession curves, and draft-storage frequency curves were developed for various groups of selected gaging stations.

Sufficient data were available for the construction of a profile of durations of flow for the Genesee River which facilitates estimates of discharge for selected durations along the stream.

There are many streams in the basin which have sufficient discharge at all times of the year to supply large quantities of water on a steady basis. Other streams require that storage facilities be provided to augment periods of low flow, and some streams are almost entirely inadequate for development as water supplies.

At this time a large amount of information is available to aid in the planning for best use of the surface waters of the basin. However, it is necessary to be aware that the extrapolation of low-flow data from a gaged to an ungaged site is not advisable without careful study, even for points on the same stream. At the least, a field reconnaissance should be made for each ungaged site to determine specific

conditions at that particular locale. Some consideration should also be given to the influence of withdrawal or use of surface water on the rest of the hydrologic environment in the basin.

As yet, little can be accomplished by way of preventing droughts. Nevertheless, if sufficient analyses such as those in this report are available, water managers can do much to ease the accompanying consequences.

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APPENDIX SECTION Ia

Summary of flow information for gaging stations in the Genesee River basin with at least three years of record

2205. Dyke Creek at Wellsville, N.Y.

LOCATION.--Lat 42°07'14", long 77°56'13", near center of span on upstream side of Miller Street Bridge at Wellsville, Allegany County, 0.6 mile upstream from mouth and 1.2 miles downstream from Trapping Brook.
RECORDS AVAILABLE.-- August 1955 to September 1960 (discontinued).
AVERAGE DISCHARGE.-- 5 years, 105 cfs.
DRAINAGE AREA.--71.4 sq mi.
MINIMUM DAILY DISCHARGE.-- 1.0 cfs.

MINIMUM AVERAGE DISCHARGE, IN CFS, FOR INDICATED LENGTH OF PERIOD

Period	Discharge	Period	Discharge
3-day	1.1	90-day	2.7
7-day	1.3	120-day	3.4
14-day	1.4	150-day	4.7
30-day	1.6	183-day	6.8
60-day	2.2	274-day	13.3

MAGNITUDE AND FREQUENCY OF ANNUAL LOW FLOW BASED ON THE PERIOD OF RECORD

Period (consecutive days)	Discharge in cfs, for indicated recurrence intervals in years				
	2	5	10	20	30
1	2.5	1.9	1.6	1.2	-
7	3.0	2.0	1.8	1.4	-
30	4.5	2.8	2.3	1.8	-

DURATION OF DAILY FLOW

Water years	Discharge, in cfs, which was equaled or exceeded for indicated percent of time																	
	1	5	10	15	20	30	40	50	60	70	80	85	90	95	98	99	99.5	99.9
1956-60	920	380	245	180	140	90	61	43	31	21	12	7.7	4.9	3.1	2.2	1.8	1.6	1.2
1931-60	810	350	220	160	120	77	52	36	25	16	8.4	6.3	4.5	3.0	2.2	1.9	1.6	1.2

Remarks.-- No known regulation or diversion. Operated as a low-flow and crest-stage partial-record station 1964-65.

2210. Genesee River at Wellsville, N.Y.

LOCATION.--Lat 42°07'20", long 77°57'00", near center of span on upstream side of West Pearl Street Bridge at Wellsville, Allegany County, 0.2 mile downstream from Dyke Creek.
RECORDS AVAILABLE.--August 1955 to September 1958 (discontinued).
AVERAGE DISCHARGE.--3 years, 437 cfs.
DRAINAGE AREA.--288 sq mi.
MINIMUM DAILY DISCHARGE.-- 18 cfs.

MINIMUM AVERAGE DISCHARGE, IN CFS, FOR INDICATED LENGTH OF PERIOD

Period	Discharge	Period	Discharge
3-day	19	90-day	25
7-day	20	120-day	28
14-day	21	150-day	31
30-day	22	183-day	40
60-day	24	274-day	70

MAGNITUDE AND FREQUENCY OF ANNUAL LOW FLOW BASED ON THE PERIOD OF RECORD

Period (consecutive days)	Discharge in cfs, for indicated recurrence intervals in years				
	2	5	10	20	30
1	-	-	-	-	-
7	-	-	-	-	-
30	-	-	-	-	-

DURATION OF DAILY FLOW

Water years	Discharge, in cfs, which was equaled or exceeded for indicated percent of time																	
	1	5	10	15	20	30	40	50	60	70	80	85	90	95	98	99	99.5	99.9
1956-58	3,500	1,550	1,050	780	610	410	275	190	135	96	67	53	38	26	22	21	20	18
1931-60	3,200	1,500	940	700	530	340	235	160	115	76	49	40	30	20	16	14	12	9.0

Remarks.--No known regulation or diversion. Frequency data have not been provided for this station because of the short period of record and because such data are shown for Genesee River at Scio (a drainage area increase at only about 10 percent).

2215. Genesee River at Scio, N.Y.

LOCATION.--Lat 42°09'50", long 77°58'50", on left bank 0.4 mile upstream from Vandermark Creek and three-quarters of a mile upstream from Scio, Allegany County.
RECORDS AVAILABLE.--June 1916 to September 1964.
AVERAGE DISCHARGE.-- 48 years, 384 cfs.
DRAINAGE AREA.--309 sq mi.
MINIMUM DAILY DISCHARGE.--6.9 cfs.

MINIMUM AVERAGE DISCHARGE, IN CFS, FOR INDICATED LENGTH OF PERIOD

Period	Discharge	Period	Discharge
3-day	7.0	90-day	18
7-day	7.3	120-day	20
14-day	7.9	150-day	22
30-day	10	183-day	22
60-day	15	274-day	41

MAGNITUDE AND FREQUENCY OF ANNUAL LOW FLOW BASED ON THE PERIOD 1917-59

Period (consecutive days)	Discharge in cfs, for indicated recurrence intervals, in years				
	2	5	10	20	30
1	21	16	14	10	8
7	24	18	15	11	9
30	31	23	20	16	13

DURATION OF DAILY FLOW

Water years	Discharge, in cfs, which was equaled or exceeded for indicated percent of time																	
	1	5	10	15	20	30	40	50	60	70	80	85	90	95	98	99	99.5	99.9
1917-60	3,200	1,400	930	690	550	370	255	180	125	87	57	44	34	26	20	17	15	10
1931-60	3,300	1,500	960	710	550	360	250	175	120	80	51	41	32	24	19	16	14	9.5

Remarks.--No known regulation or diversion.

APPENDIX SECTION 1a (Continued)

2220. Caneadea Creek at Caneadea, N.Y.

LOCATION.--Lat 42°23'10", long 78°09'45", on left bank at Caneadea, Allegany County, 800 ft upstream from unnamed tributary and 0.6 mile upstream from mouth.
RECORDS AVAILABLE.--July 1949 to September 1964.
AVERAGE DISCHARGE.--15 years, 85.9 cfs (adjusted for storage).
DRAINAGE AREA.--61.5 sq mi.
MINIMUM DAILY DISCHARGE.--0.8 cfs.

MINIMUM AVERAGE DISCHARGE, IN CFS, FOR INDICATED LENGTH OF PERIOD

Period	Discharge	Period	Discharge
3-day	0.9	90-day	2.4
7-day	1.0	120-day	3.6
14-day	1.0	150-day	6.9
30-day	1.4	183-day	15
60-day	1.6	274-day	41

MAGNITUDE AND FREQUENCY OF ANNUAL LOW FLOW BASED ON THE PERIOD 1950-59.

Period (consecutive days)	Discharge in cfs, for indicated recurrence intervals in years				
	2	5	10	20	30
1	1.4	1.0	0.9	0.8	-
7	1.5	1.1	1.0	.9	-
30	2.3	1.6	1.4	1.2	-

DURATION OF DAILY FLOW

Water years	Discharge, in cfs, which was equaled or exceeded for indicated percent of time																	
	1	5	10	15	20	30	40	50	60	70	80	85	90	95	98	99	99.5	99.9
1950-60	650	420	330	260	190	56	18	8.8	5.9	4.3	3.2	2.6	2.2	1.7	1.4	1.3	1.2	1.0
1931-60	650	420	325	240	160	42	14	8.0	5.7	4.1	3.0	2.5	2.1	1.6	1.3	1.1	1.0	0.8

Remarks.--Considerable regulation by Rushford Lake (capacity, 1,106,000,000 cu ft) about 2 miles upstream from station.

2230. Genesee River at Portageville, N.Y.

LOCATION.--Lat 42°34'10", long 78°02'45", on left bank at Portageville, Wyoming County, 300 ft downstream from small tributary, 350 ft downstream from Pennsylvania Railroad bridge, and 0.7 mile upstream from Upper Falls.
RECORDS AVAILABLE.--August 1908 to September 1964.*
AVERAGE DISCHARGE.--56 years, 1,215 cfs (unadjusted).
DRAINAGE AREA.--982 sq mi. Prior to Oct. 1, 1946, 1,017 sq mi.
MINIMUM DAILY DISCHARGE.--20 cfs.

MINIMUM AVERAGE DISCHARGE, IN CFS, FOR INDICATED LENGTH OF PERIOD

Period	Discharge	Period	Discharge
3-day	30	90-day	68
7-day	34	120-day	87
14-day	40	150-day	115
30-day	49	183-day	142
60-day	58	274-day	213

MAGNITUDE AND FREQUENCY OF ANNUAL LOW FLOW BASED ON THE PERIOD 1909-59.

Period (consecutive days)	Discharge in cfs, for indicated recurrence intervals in years				
	2	5	10	20	30
1	76	54	40	29	25
7	98	65	50	42	38
30	130	84	66	55	50

DURATION OF DAILY FLOW

Water years	Discharge, in cfs, which was equaled or exceeded for indicated percent of time																	
	1	5	10	15	20	30	40	50	60	70	80	85	90	95	98	99	99.5	99.9
1909-60	11,000	4,600	2,900	2,100	1,650	1,100	790	570	410	290	200	165	130	95	71	60	53	40
1931-60	10,500	4,400	2,800	2,100	1,650	1,150	800	580	420	300	200	165	125	92	69	59	50	37

Remarks.--Some seasonal regulation by Rushford Lake (capacity, 1,106,000,000 cu ft) since July 1928. Diurnal fluctuation at low flow caused by powerplants.

* Prior to December 1945 published as "at St. Helena". Records published for both sites December 1945 to September 1950.

2250. Canaseraga Creek near Dansville, N.Y.

LOCATION.--Lat 42°33'40", long 77°42'55", on left bank just downstream from Ossian Street Bridge, half a mile downstream from Mill Creek and 1 mile west of Dansville, Livingston County.
RECORDS AVAILABLE.--Various periods from 1910-12, 1915-19, March 1919 to September 1964.*
AVERAGE DISCHARGE.--49 years (1910-12, 1915-16, 1917-19, 1920-64), 152 cfs.
DRAINAGE AREA.--153 sq mi Oct. 1917 to Sept. 1919, Oct. 1938 to Sept. 1940, 155 sq mi.
MINIMUM DAILY DISCHARGE.--10 cfs.

MINIMUM AVERAGE DISCHARGE, IN CFS, FOR INDICATED LENGTH OF PERIOD

Period	Discharge	Period	Discharge
3-day	11	90-day	16
7-day	12	120-day	17
14-day	13	150-day	18
30-day	14	183-day	20
60-day	16	274-day	28

MAGNITUDE AND FREQUENCY OF ANNUAL LOW FLOW BASED ON THE PERIOD 1911, 1921-59.

Period (consecutive days)	Discharge in cfs, for indicated recurrence intervals, in years				
	2	5	10	20	30
1	20	16	14	12	11
7	22	17	15	13	12
30	25	20	17	15	14

DURATION OF DAILY FLOW

Water years	Discharge, in cfs, which was equaled or exceeded for indicated percent of time																	
	1	5	10	15	20	30	40	50	60	70	80	85	90	95	98	99	99.5	99.9
1916, 1921-60	1,350	540	340	250	200	135	98	70	53	41	33	29	25	22	18	17	15	13
1931-60	1,300	530	330	250	200	135	96	69	51	39	31	27	24	21	18	16	15	12

Remarks.--No known regulation. Some small amounts diverted upstream for purposes of irrigation and water supply.

* Published as "at Cumminsville", October 1917 to September 1919. Monthly discharge only for some periods, published in WSP 1307.

2255. Canaseraga Creek at Groveland, N.Y.

LOCATION.--Lat 42°39'45", long 77°46'10", on left bank at downstream side of highway bridge at Groveland, Livingston County, 0.2 mile downstream from small tributary.
RECORDS AVAILABLE.--Various periods 1915-16, 1917-20*; October 1955 to September 1964 (discontinued).
AVERAGE DISCHARGE.--10 years (1918-19, 1955-64), 180 cfs. MINIMUM DAILY DISCHARGE.-- 15 cfs.
DRAINAGE AREA.--181 sq mi.

MINIMUM AVERAGE DISCHARGE, IN CFS, FOR INDICATED LENGTH OF PERIOD

Period	Discharge	Period	Discharge
3-day	16	90-day	27
7-day	17	120-day	29
14-day	17	150-day	29
30-day	19	183-day	30
60-day	24	274-day	54

MAGNITUDE AND FREQUENCY OF ANNUAL LOW FLOW BASED ON THE PERIOD 1916-18, 1956-62.

Period (consecutive days)	Discharge in cfs, for indicated recurrence intervals in years				
	2	5	10	20	30
1	22	18	16	14	-
7	25	20	17	15	-
30	28	22	20	18	-

DURATION OF DAILY FLOW

Water years	Discharge, in cfs, which was equaled or exceeded for indicated percent of time																	
	1	5	10	15	20	30	40	50	60	70	80	85	90	95	98	99	99.5	99.9
1916-19, 1956-63	1,700	700	430	330	260	185	130	100	71	54	42	37	32	28	23	21	19	17
1931-60	1,450	610	410	310	250	170	115	81	60	47	37	33	29	25	21	20	18	16

Remarks.--Overflow of left bank occurs upstream at extremely high stages. Water returns to channel below station. Some small amounts diverted upstream for purposes of irrigation and water supply.

* Gage heights and discharge measurements only, August 1915 to September 1916; no winter records in 1917, 1918, 1920, published as "at Groveland Station".

2260. Keshequa Creek at Craig Colony, Sonyea, N.Y.

LOCATION.--Lat 42°40'55", long 77°49'45", on right bank 200 ft downstream from private bridge on grounds of Craig Craig Colony at Sonyea, Livingston County, about 2 miles upstream from mouth.*
RECORDS AVAILABLE.--Various periods 1911,12,15,16; August 1917 to September 1932 (discontinued).
AVERAGE DISCHARGE.--15 years (1917-32), 49.7 cfs. MINIMUM DAILY DISCHARGE.-- 0.1 cfs
DRAINAGE AREA.--69.1 sq mi. Sept. 1915 to Oct. 1917, 76.5 sq mi.

MINIMUM AVERAGE DISCHARGE, IN CFS, FOR INDICATED LENGTH OF PERIOD

Period	Discharge	Period	Discharge
3-day	0.2	90-day	1.7
7-day	.4	120-day	2.3
14-day	.6	150-day	2.8
30-day	1.0	183-day	3.1
60-day	1.1	274-day	6.3

MAGNITUDE AND FREQUENCY OF ANNUAL LOW FLOW BASED ON THE PERIOD 1918-31.

Period (consecutive days)	Discharge in cfs, for indicated recurrence intervals in years				
	2	5	10	20	30
1	1.2	0.8	0.6	0.5	-
7	1.5	1.0	.8	.7	-
30	2.6	1.5	1.1	.9	-

DURATION OF DAILY FLOW

Water years	Discharge, in cfs, which was equaled or exceeded for indicated percent of time																	
	1	5	10	15	20	30	40	50	60	70	80	85	90	95	98	99	99.5	99.9
1918-32	640	200	110	72	54	33	23	16	11	7.8	5.4	4.3	3.1	1.9	1.2	0.9	0.6	0.2
1931-60	640	190	110	76	58	36	25	18	12	8.6	5.4	4.0	2.9	1.7	1.0	.6	.2	.1

Remarks.--No known regulation or diversions.

* At different (though near by) sites 1911 and 1912, 1915 to 1917.

2270. Canaseraga Creek at Shakers Crossing, N.Y.

LOCATION.--Lat 42°44'15", long 77°50'30", on left bank at upstream side of highway bridge at Shakers Crossing, about 1 mile upstream from mouth and 1-1/2 miles northeast of Mount Morris, Livingston County.
RECORDS AVAILABLE.--July 1915 to September 1922 (gage heights only), November 1958 to September 1964.
AVERAGE DISCHARGE.--5 years (1959-64), 269 cfs. MINIMUM DAILY DISCHARGE.-- 17 cfs.
DRAINAGE AREA.--333 sq mi.

MINIMUM AVERAGE DISCHARGE, IN CFS, FOR INDICATED LENGTH OF PERIOD

Period	Discharge	Period	Discharge
3-day	18	90-day	31
7-day	19	120-day	34
14-day	20	150-day	35
30-day	21	183-day	35
60-day	28	274-day	87

MAGNITUDE AND FREQUENCY OF ANNUAL LOW FLOW BASED ON THE PERIOD 1960-62.

Period (consecutive days)	Discharge in cfs, for indicated recurrence intervals, in years				
	2	5	10	20	30
1	25	20	18	17	-
7	28	22	20	18	-
30	33	25	22	20	-

DURATION OF DAILY FLOW

Water years	Discharge, in cfs, which was equaled or exceeded for indicated percent of time																	
	1	5	10	15	20	30	40	50	60	70	80	85	90	95	98	99	99.5	99.9
1960-63	2,250	1,050	680	520	425	270	165	105	71	52	41	38	33	27	23	21	19	18
1931-60	2,200	1,150	760	560	440	285	180	115	80	59	45	40	34	28	24	22	21	19

Remarks.--Some small amounts diverted upstream for purposes of irrigation and water supply. This site subject to backwater from Genesee River during periods of high flow.

2275. Genesee River at Jones Bridge, near Mount Morris, N.Y.

LOCATION.--Lat 42°45'55", long 77°50'25", on right bank at Jones Bridge, 1-1/2 miles downstream from Canaseraga Creek and 3-1/2 miles northeast of Mount Morris, Livingston County.
RECORDS AVAILABLE.--May 1903 to April 1906, August 1908 to April 1914, July 1915 to September 1964.
AVERAGE DISCHARGE.-- 54 years (1908-13,1915-64) 1,597 cfs (unadjusted). MINIMUM DAILY DISCHARGE.--30 cfs.
DRAINAGE AREA.-- 1,419 sq mi.

MINIMUM AVERAGE DISCHARGE, IN CFS, FOR INDICATED LENGTH OF PERIOD

Period	Discharge	Period	Discharge
3-day	48	90-day	90
7-day	54	120-day	113
14-day	60	150-day	139
30-day	71	183-day	181
60-day	79	274-day	274

MAGNITUDE AND FREQUENCY OF ANNUAL LOW FLOW BASED ON THE PERIOD 1909-13,1917-59.

Period (consecutive days)	Discharge in cfs, for indicated recurrence intervals in years				
	2	5	10	20	30
1	105	63	46	36	33
7	140	90	70	60	55
30	190	120	98	81	75

DURATION OF DAILY FLOW

Water years	Discharge, in cfs, which was equaled or exceeded for indicated percent of time																	
	1	5	10	15	20	30	40	50	60	70	80	85	90	95	98	99	99.5	99.9
1909-13, 1916-51	13,500	6,100	3,750	2,700	2,100	1,400	990	730	550	400	290	240	195	140	105	85	71	50
1952-60*	10,000	6,900	4,500	3,100	2,400	1,700	1,200	850	560	390	265	210	165	125	97	84	71	50

Remarks.-- Diurnal fluctuation at low flow caused by powerplants. Flow regulated to some extent by Rushford Lake (capacity, 1,106,000,000 cu ft) since July 1928 and, at high flows since November 1951 by Mount Morris Reservoir.
* Subsequent to the construction of Morris Dam.

2280. Conesus Creek near Lakeville, N.Y.

LOCATION.--Lat 42°51'20", long 77°43'00", on upstream side of right abutment of Millville Bridge, 1-1/2 miles downstream from Lakeville, Livingston County.
RECORDS AVAILABLE.-- October 1919 to September 1934 (discontinued).
AVERAGE DISCHARGE.-- 15 years (1919-34), 48.3 cfs. MINIMUM DAILY DISCHARGE.-- 0.4 cfs.
DRAINAGE AREA.-- 72.0 sq mi.

MINIMUM AVERAGE DISCHARGE, IN CFS, FOR INDICATED LENGTH OF PERIOD

Period	Discharge	Period	Discharge
3-day	0.5	90-day	1.2
7-day	.5	120-day	1.2
14-day	.8	150-day	1.8
30-day	.9	183-day	2.0
60-day	1.0	274-day	7.6

MAGNITUDE AND FREQUENCY OF ANNUAL LOW FLOW BASED ON THE PERIOD OF RECORD.

Period (consecutive days)	Discharge in cfs, for indicated recurrence intervals in years				
	2	5	10	20	30
1	3.5	0.8	0.5	0.3	-
7	4.0	1.0	.6	.4	-
30	5.0	1.7	1.1	.8	-

DURATION OF DAILY FLOW

Water years	Discharge, in cfs, which was equaled or exceeded for indicated percent of time																	
	1	5	10	15	20	30	40	50	60	70	80	85	90	95	98	99	99.5	99.9
1920-34	250	160	122	100	84	57	38	27	20	14	8.9	5.4	3.3	2.0	1.3	1.0	0.8	0.6
1931-60	290	170	125	105	88	64	46	31	22	16	10	6.4	3.5	2.0	1.3	1.1	.9	.7

Remarks.-- Considerable regulation by Conesus Lake. Water supply for Villages of Avon and Geneseo taken from Conesus Lake.

2285. Genesee River at Avon, N.Y.

LOCATION.--Lat 42°55'05", long 77°45'30", on left bank at downstream side of bridge on U.S. Highway 20 (State Highway 5), 0.3 mile west of Avon, Livingston County, and 0.8 mile downstream from Conesus Creek.
RECORDS AVAILABLE.--August 1955 to September 1964.
AVERAGE DISCHARGE.--9 years, 1,826 cfs (unadjusted). MINIMUM DAILY DISCHARGE.-- 63 cfs.
DRAINAGE AREA.--1,666 sq mi.

MINIMUM AVERAGE DISCHARGE, IN CFS, FOR INDICATED LENGTH OF PERIOD

Period	Discharge	Period	Discharge
3-day	107	90-day	164
7-day	124	120-day	185
14-day	136	150-day	229
30-day	141	183-day	298
60-day	151	274-day	445

MAGNITUDE AND FREQUENCY OF ANNUAL LOW FLOW BASED ON THE PERIOD 1956-59.

Period (consecutive days)	Discharge in cfs, for indicated recurrence intervals, in years				
	2	5	10	20	30
1	130	80	62	-	-
7	155	95	75	-	-
30	200	125	100	-	-

DURATION OF DAILY FLOW

Water years	Discharge, in cfs, which was equaled or exceeded for indicated percent of time																	
	1	5	10	15	20	30	40	50	60	70	80	85	90	95	98	99	99.5	99.9
1956-60	11,800	8,400	6,100	4,000	3,100	2,100	1,550	1,150	780	520	350	285	210	160	135	125	115	80
1952-60	11,200	7,700	5,200	3,600	2,900	2,050	1,450	950	640	440	300	240	185	150	125	105	90	74

Remarks.--Diurnal fluctuation at low flow caused by powerplants. Flow regulated to some extent by Rushford Lake (capacity, 1,106,000,000 cu ft), and, at high flows, by Mt. Morris Reservoir.

2295. Honeoye Creek at Honeoye Falls, N.Y.

LOCATION.--Lat 42°57'25", long 77°35'20", on right bank 25 ft downstream from highway bridge at Honeoye Falls, Monroe County, and 13 miles upstream from mouth.
RECORDS AVAILABLE.--October 1945 to September 1964.
AVERAGE DISCHARGE.--19 years, 165 cfs (adjusted for storage and diversion). MINIMUM DAILY DISCHARGE.-- 0.1 cfs.
DRAINAGE AREA.--197 sq mi.

MINIMUM AVERAGE DISCHARGE, IN CFS, FOR INDICATED LENGTH OF PERIOD

Period	Discharge	Period	Discharge
3-day	0.1	90-day	0.8
7-day	.1	120-day	1.1
14-day	.2	150-day	1.5
30-day	.7	183-day	2.1
60-day	.8	274-day	12

MAGNITUDE AND FREQUENCY OF ANNUAL LOW FLOW BASED ON THE PERIOD 1946-59.

Period (consecutive days)	Discharge in cfs, for indicated recurrence intervals in years				
	2	5	10	20	30
1	0.7	0.2	0.2	0.1	-
7	1.0	.4	.3	.2	-
30	1.8	.9	.7	.6	-

DURATION OF DAILY FLOW

Water years	Discharge, in cfs, which was equaled or exceeded for indicated percent of time																	
	1	5	10	15	20	30	40	50	60	70	80	85	90	95	98	99	99.5	99.9
1946-60	1,000	475	310	230	180	115	75	47	25	12	5.2	3.5	2.1	1.1	0.7	0.5	0.4	0.2
1931-60	1,000	460	300	220	170	100	63	35	20	10	4.7	3.1	1.8	.9	.5	.3	.2	.1

Remarks.--Some diversion from and regulation by Hemlock and Canadice Lakes for water supply of city of Rochester. Diurnal fluctuation at low flow caused by mills above station.

2305. Oatka Creek at Garbutt, N.Y.

LOCATION.--Lat 43°00'30", long 77°47'25", on right bank 40 ft downstream from highway bridge at Garbutt, Monroe County, 2 miles southwest of Scottsville, and 3-1/2 miles upstream from mouth.
RECORDS AVAILABLE.--October 1945 to September 1964.
AVERAGE DISCHARGE.--19 years, 195 cfs. MINIMUM DAILY DISCHARGE.-- 16 cfs.
DRAINAGE AREA.--208 sq mi.

MINIMUM AVERAGE DISCHARGE, IN CFS, FOR INDICATED LENGTH OF PERIOD

Period	Discharge	Period	Discharge
3-day	17	90-day	22
7-day	20	120-day	23
14-day	20	150-day	25
30-day	21	183-day	27
60-day	22	274-day	47

MAGNITUDE AND FREQUENCY OF ANNUAL LOW FLOW BASED ON THE PERIOD 1946-59.

Period (consecutive days)	Discharge in cfs, for indicated recurrence intervals in years				
	2	5	10	20	30
1	23	18	16	15	-
7	24	20	19	18	-
30	26	22	22	21	-

DURATION OF DAILY FLOW

Water years	Discharge, in cfs, which was equaled or exceeded for indicated percent of time																	
	1	5	10	15	20	30	40	50	60	70	80	85	90	95	98	99	99.5	99.9
1946-60	1,700	780	510	380	300	195	130	88	59	44	35	31	28	24	22	21	20	18
1931-60	1,700	770	490	365	280	180	115	74	53	42	33	30	26	23	21	19	18	16

Remarks.-- No known regulation or diversions.

2310. Black Creek at Churchville, N.Y.

LOCATION.--Lat 43°06'00", long 77°53'00", on right bank at east end of Carrol Street in Churchville, Monroe County, 60 ft downstream from main-line tracks of New York Central Railroad and 1 mile upstream from unnamed tributary.
RECORDS AVAILABLE.--October 1945 to September 1964.
AVERAGE DISCHARGE.-- 19 years, 101 cfs. MINIMUM DAILY DISCHARGE.-- 0.3 cfs.
DRAINAGE AREA.-- 123 sq mi.

MINIMUM AVERAGE DISCHARGE, IN CFS, FOR INDICATED LENGTH OF PERIOD

Period	Discharge	Period	Discharge
3-day	0.3	90-day	3.4
7-day	.5	120-day	5.2
14-day	1.1	150-day	6.3
30-day	1.7	183-day	8.0
60-day	2.1	274-day	19

MAGNITUDE AND FREQUENCY OF ANNUAL LOW FLOW BASED ON THE PERIOD 1946-59.

Period (consecutive days)	Discharge in cfs, for indicated recurrence intervals, in years				
	2	5	10	20	30
1	2.5	1.3	0.6	0.2	-
7	3.1	1.7	.9	.4	-
30	5.0	3.5	2.5	1.5	-

DURATION OF DAILY FLOW

Water years	Discharge, in cfs, which was equaled or exceeded for indicated percent of time																	
	1	5	10	15	20	30	40	50	60	70	80	85	90	95	98	99	99.5	99.9
1946-60	950	460	285	200	150	90	56	37	24	15	9.0	7.0	5.4	4.0	2.8	2.0	1.2	0.6
1931-60	1,000	460	280	190	140	80	49	31	20	13	8.6	6.7	5.1	3.4	1.8	.7	.4	.2

Remarks.-- Prior to May 1952, small diversion by New York Central Railroad Co. and slight regulation by pumping operation above station.

2320. Genesee River at Driving Park Avenue, Rochester, N.Y.

LOCATION.--Lat 43°10'50", long 77°37'40", on right bank at Rochester, Monroe County, 40 ft downstream from plant 5 of Rochester Gas & Electric Corp. and 100 ft upstream from Driving Park Avenue Bridge.
RECORDS AVAILABLE.--December 1919 to September 1964.
AVERAGE DISCHARGE.--44 years (1920-64), 2,726 cfs.
DRAINAGE AREA.--2,467 sq mi.

MINIMUM DAILY DISCHARGE.-- 91 cfs.

MINIMUM AVERAGE DISCHARGE, IN CFS, FOR INDICATED LENGTH OF PERIOD

Period	* Discharge	**	Period	* Discharge	**
3-day	290	334	90-day	673	489
7-day	321	354	120-day	709	510
14-day	365	360	150-day	733	609
30-day	569	400	183-day	793	690
60-day	640	467	274-day	987	824

MAGNITUDE AND FREQUENCY OF ANNUAL LOW FLOW BASED ON THE PERIOD INDICATED.

Period (consecutive days)	Discharge in cfs, for indicated recurrence intervals in years							
	* 2	**	* 5	**	* 10	**	* 20	** 30
1	620	400	430	330	350	290	280	250
7	760	460	660	410	530	370	400	320
30	860	560	740	470	660	420	600	350

DURATION OF DAILY FLOW

Water years	Discharge, in cfs, which was equaled or exceeded for indicated percent of time																	
	1	5	10	15	20	30	40	50	60	70	80	85	90	95	98	99	99.5	99.9
1921-48*	17,500	9,900	6,100	4,500	3,600	2,600	1,950	1,550	1,300	1,120	960	890	830	770	690	620	550	380
1949-60**	15,700	10,500	6,800	4,700	3,900	2,850	2,150	1,600	1,150	880	710	650	575	500	435	410	385	340

Remarks.--Extensive diurnal fluctuation caused by powerplants above station. New York State Erie (Barge) Canal crosses river 5.4 miles above station. Water diverted by the canal from Lake Erie is discharged into river from the west, the canal again diverting a smaller amount of water from river to the east. Additional regulation is provided by Rushford Lake and Mount Morris Reservoir.

Note.--During the 1949 water year, the low-flow pattern of diversion from the canal was changed.
* Period 1921-48. Maximum diversion from canal about 600 cfs.
** Period 1949-60. Maximum diversion from canal about 375 cfs.

APPENDIX SECTION 1b

Summary of flow information for gaging stations in the Genesee River basin with less than three years of record

2204.7. Dyke Creek near Andover, N.Y.

LOCATION.--Lat 42°09'54", long 77°49'13", on right bank 12 ft downstream from old highway bridge on former N.Y. Route 17, about 1.4 miles west of Andover, Allegany County.
RECORDS AVAILABLE.--February 1964 to September 1965.
DRAINAGE AREA.--37.4 sq mi.

MAGNITUDE & FREQUENCY OF ANNUAL LOW FLOWS

Period (consecutive days)	Discharge, in cfs, for indicated recurrence intervals, in years		
	2	5	10
1	1.4	1.1	1.0
7	1.7	1.2	1.0
30	2.4	1.5	1.3

Remarks.-- No known regulation or diversion.

ADJUSTED TO STANDARD PERIOD, WATER YEARS 1931-60

Average discharge.-- 38 cfs

Duration of daily flow	Discharge, in cfs, which was equaled or exceeded for indicated percent of time								
	50	60	70	80	85	90	95	98	99
	17	12	8.2	5.2	3.9	2.7	1.8	1.2	1.1

2216. Van Campen Creek at Friendship, N.Y.

LOCATION.-- Lat 42°12'22", long 78°07'46", on left bank 45 ft downstream from Moss St. bridge in village of Friendship, Allegany County.

RECORDS AVAILABLE.-- January 1964 to September 1965. Occasional low-flow measurements, water years 1957-62.
DRAINAGE AREA.-- 45.8 sq mi.

MAGNITUDE & FREQUENCY OF ANNUAL LOW FLOWS

Period (consecutive days)	Discharge, in cfs, for indicated recurrence intervals, in years		
	2	5	10
1	1.2	0.9	0.7
7	1.5	.9	.7
30	2.3	1.4	1.1

Remarks.-- Slight diversion from upstream tributary for gravel-wash operation.

ADJUSTED TO STANDARD PERIOD, WATER YEARS 1931-60

Average discharge.--65 cfs

Duration of daily flow	Discharge, in cfs, which was equaled or exceeded for indicated percent of time								
	50	60	70	80	85	90	95	98	99
	27	17	10	5.1	3.8	2.7	1.7	1.1	0.9

2217.2 Angelica Creek at Transit Bridge, N.Y.

LOCATION.-- Lat 42°17'44", long 78°03'29", on right bank 75 ft downstream from bridge on County Highway 43, 0.4 mile upstream from mouth, and 0.9 mile east of Transit Bridge, Allegany County.
RECORDS AVAILABLE.-- February 1964 to September 1965.
DRAINAGE AREA.-- 84.6 sq mi.

MAGNITUDE & FREQUENCY OF ANNUAL LOW FLOWS

Period (consecutive days)	Discharge, in cfs, for indicated recurrence intervals, in years		
	2	5	10
1	1.8	1.4	1.2
7	2.2	1.5	1.3
30	3.2	2.1	1.6

Remarks.--No known regulation or diversion.

ADJUSTED TO STANDARD PERIOD, WATER YEARS 1931-60

Average discharge.--80 cfs

Duration of daily flow	Discharge, in cfs, which was equaled or exceeded for indicated percent of time								
	50	60	70	80	85	90	95	98	99
	31	20	12	6.9	5.0	3.5	2.4	1.7	1.4

2218.2 Genesee River at Belfast, N.Y.

LOCATION.--Lat 42°20'37", long 78°06'15", on left bank 100 ft downstream from Genesee River bridge in village of Belfast, Allegany County.

RECORDS AVAILABLE.--February 1964 to September 1965.
DRAINAGE AREA.-- 641 sq mi.

MAGNITUDE & FREQUENCY OF ANNUAL LOW FLOWS

Period (consecutive days)	Discharge, in cfs, for indicated recurrence intervals, in years		
	2	5	10
1	28	22	20
7	33	25	21
30	44	31	26

Remarks.-- No known regulation or diversion.

ADJUSTED TO STANDARD PERIOD, WATER YEARS 1931-60

Average discharge.--820 cfs

Duration of daily flow	Discharge, in cfs, which was equaled or exceeded for indicated percent of time								
	50	60	70	80	85	90	95	98	99
	300	170	110	73	59	46	34	27	23

2229. East Koy Creek at East Koy, N.Y.

LOCATION.-- Lat 42°32'27", long 78°05'54", on left bank 150 feet downstream from bridge on County Highway 29, about 0.3 mile east of East Koy, Wyoming County, and about 2.2 miles upstream from mouth.
RECORDS AVAILABLE.-- January 1964 to September 1965.
DRAINAGE AREA.--46.2 sq mi.

MAGNITUDE & FREQUENCY OF ANNUAL LOW FLOWS

Period (consecutive days)	Discharge, in cfs, for indicated recurrence intervals, in years		
	2	5	10
1	7.6	6.0	5.6
7	8.8	6.6	5.7
30	11	8.0	6.8

Remarks.-- Some seasonal diversion for irrigation upstream.

ADJUSTED TO STANDARD PERIOD, WATER YEARS 1931-60

Average discharge.-- 80 cfs

Duration of daily flow	Discharge, in cfs, which was equaled or exceeded for indicated percent of time								
	50	60	70	80	85	90	95	98	99
	36	27	21	16	14	12	9.2	7.3	6.4

APPENDIX SECTION 1b (Continued)

2246.5. Canaseraga Creek near Canaseraga, N.Y.

LOCATION.--Lat 42°28'18", long 77°45'24", on right bank 150 ft upstream from bridge on road to village disposal area, 1.2 miles northeast of village of Canaseraga, Allegany County.
RECORDS AVAILABLE.-- January 1964 to September 1965.
DRAINAGE AREA.-- 58.3 sq mi.

MAGNITUDE & FREQUENCY OF ANNUAL LOW FLOWS

Period (consecutive days)	Discharge, in cfs, for indicated recurrence intervals, in years		
	2	5	10
1	1.5	1.1	1.0
7	1.8	1.2	1.1
30	2.6	1.5	1.2

Remarks.-- No known regulation or diversion.

ADJUSTED TO STANDARD PERIOD, WATER YEARS 1931-60

Average discharge.-- 55 cfs

Duration of daily flow	Discharge, in cfs, which was equaled or exceeded for indicated percent of time								
	50	60	70	80	85	90	95	98	99
	22	15	9.7	5.8	4.2	2.8	1.8	1.4	1.2

2289. Springwater Creek at Springwater, N.Y.

LOCATION.-- Lat 42°38'37", long 77°36'12", on left bank at downstream side of bridge on *Wheeler Road, and about 0.5 mile northwest* of Springwater, Livingston, County.
RECORDS AVAILABLE.-- January 1964 to September 1965
DRAINAGE AREA.-- 10.1 sq mi.

MAGNITUDE & FREQUENCY OF ANNUAL LOW FLOWS

Period (consecutive days)	Discharge, in cfs, for indicated recurrence intervals, in years		
	2	5	10
1	0.5	0.2	0.2
7	.8	.4	.2
30	1.4	.8	.4

Remarks.-- No known regulation or diversion.

ADJUSTED TO STANDARD PERIOD, WATER YEARS 1931-60

Average discharge.-- 15 cfs

Duration of daily flow	Discharge, in cfs, which was equaled or exceeded for indicated percent of time								
	50	60	70	80	85	90	95	98	99
	7.4	5.4	3.8	2.5	2.1	1.5	1.0	0.5	0.4

2303.8 Oatka Creek at Warsaw, N.Y.

LOCATION.--Lat 42°44'39", long 78°08'16", on right bank 400 ft downstream from bridge on Court St., Warsaw, Wyoming County.

RECORDS AVAILABLE.-- December 1963 to September 1965.
DRAINAGE AREA.--42.2 sq mi.

MAGNITUDE & FREQUENCY OF ANNUAL LOW FLOWS

Period (consecutive days)	Discharge, in cfs, for indicated recurrence intervals, in years		
	2	5	10
1	1.4	1.0	0.9
7	1.6	1.2	1.0
30	2.3	1.6	1.2

Remarks.--No known regulation or diversion.

ADJUSTED TO STANDARD PERIOD, WATER YEARS 1931-60

Average discharge.--52 cfs

Duration of daily flow	Discharge, in cfs, which was equaled or exceeded for indicated percent of time								
	50	60	70	80	85	90	95	98	99
	21	13	7.5	4.3	3.3	2.5	1.8	1.3	1.1

APPENDIX SECTION 1c

Summary of flow information for partial-record stations and selected miscellaneous sites in the Genesee River basin

2203.7. Cryder Creek at Paynesville, N.Y.

LOCATION.--Lat 42°00'29", long 77°50'30", at bridge on town road, 0.15 mile southeast of Paynesville, Allegany County, and 1.9 miles upstream from mouth.
RECORDS AVAILABLE.--1954-55, 1964-65.
DRAINAGE AREA.--

MAGNITUDE & FREQUENCY OF ANNUAL LOW FLOWS

Period (consecutive days)	Discharge, in cfs, for indicated recurrence intervals, in years		
	2	5	10
1	2.6	2.1	1.9
7	3.0	2.3	2.0
30	3.8	2.8	2.4

ADJUSTED TO STANDARD PERIOD, WATER YEARS 1931-60

Average discharge.-- 58 cfs

Duration of daily flow	Discharge, in cfs, which was equaled or exceeded for indicated percent of time								
	50	60	70	80	85	90	95	98	99
	19	12	8.2	5.8	5.0	4.0	3.1	2.4	2.1

Remarks.--Stream receives some amount of oil field wastes upstream. No known regulation or diverson.

2203.9. Marsh Creek at Mapes, N.Y.

LOCATION.--Lat 42°02'54", long 77°55'53", at bridge on County Highway 29 at Mapes, Allegany County, and 0.2 mile upstream from mouth.
RECORDS AVAILABLE.--1964-65.
DRAINAGE AREA.--

MAGNITUDE & FREQUENCY OF ANNUAL LOW FLOWS

Period (consecutive days)	Discharge, in cfs, for indicated recurrence intervals, in years		
	2	5	10
1	0.3	0.2	0.2
7	.3	.2	.2
30	.6	.3	.2

ADJUSTED TO STANDARD PERIOD, WATER YEARS 1931-60

Average discharge.--17 cfs

Duration of daily flow	Discharge, in cfs, which was equaled or exceeded for indicated percent of time								
	50	60	70	80	85	90	95	98	99
	5.1	3.1	1.9	1.1	0.8	0.6	0.4	0.3	0.2

Remarks.--Beaver dams downstream occasionally back up a pool past this site. No known regulation or diversion.

2204.1. Ford Brook at Stannard, N.Y.

LOCATION.--Lat 42°04'03", long 77°55'43", at bridge on town road, 0.3 mile upstream from mouth, and 0.5 mile south of Stannard, Allegany County.
RECORDS AVAILABLE.--1955, 1964-65.
DRAINAGE AREA.--

MAGNITUDE & FREQUENCY OF ANNUAL LOW FLOWS

Period (consecutive days)	Discharge, in cfs, for indicated recurrence intervals, in years		
	2	5	10
1	0.8	0.7	0.6
7	1.0	.7	.6
30	1.3	.9	.8

ADJUSTED TO STANDARD PERIOD, WATER YEARS 1931-60

Average discharge.--17 cfs

Duration of daily flow	Discharge, in cfs, which was equaled or exceeded for indicated percent of time								
	50	60	70	80	85	90	95	98	99
	6.2	4.2	3.0	2.1	1.7	1.3	1.0	0.8	0.7

Remarks.--No known regulation or diversion.

2204.3. Chenunda Creek at Stannards Corners, N.Y.

LOCATION.--Lat 42°05'06", long 77°54'36", at bridge on town road, 0.6 mile east of Stannards Corners, Allegany County, and 1.3 miles upstream from mouth.
RECORDS AVAILABLE.--1954-55, 1964-65.
DRAINAGE AREA.--

MAGNITUDE & FREQUENCY OF ANNUAL LOW FLOWS

Period (consecutive days)	Discharge, in cfs, for indicated recurrence intervals, in years		
	2	5	10
1	1.2	0.8	0.7
7	1.3	.9	.8
30	1.8	1.0	.8

ADJUSTED TO STANDARD PERIOD, WATER YEARS 1931-60

Average discharge.--30cfs

Duration of daily flow	Discharge, in cfs, which was equaled or exceeded for indicated percent of time								
	50	60	70	80	85	90	95	98	99
	11	7.2	4.8	3.2	2.5	1.9	1.3	1.0	0.8

Remarks.--No known regulation or diversion.

2204.5. Dyke Creek near West Greenwood, N.Y.

LOCATION.--Lat 42°08'41", long 77°44'07", on downstream left loose masonry abutment wall of culvert on town road, 300 ft north of State Highway 17, 0.1 mile upstream from unnamed tributary, 1.2 miles southwest of West Greenwood, Steuben County.
RECORDS AVAILABLE.--1964-65.
DRAINAGE AREA.--1.64 sq mi.

MAGNITUDE & FREQUENCY OF ANNUAL LOW FLOWS

Period (consecutive days)	Discharge, in cfs, for indicated recurrence intervals, in years		
	2	5	10
1	0.1	0.08	0.05
7	.2	.08	.07
30	.2	.1	.1

ADJUSTED TO STANDARD PERIOD, WATER YEARS 1931-60

Average discharge.-- 2.5 cfs

Duration of daily flow	Discharge, in cfs, which was equaled or exceeded for indicated percent of time								
	50	60	70	80	85	90	95	98	99
	1.2	0.9	0.6	0.4	0.3	0.2	0.2	0.09	0.07

Remarks.-- Also a crest-stage partial-record station. No known regulation or diversion.

2204.55. Quig Hollow Brook near Andover, N.Y.

LOCATION.--Lat 42°08'45", long 77°45'25", on back of downstream right concrete bank-retaining wall, 40 ft downstream from bridge on town road, 0.2 mile upstream from mouth, 0.2 mile south of State Highway 17, and 1.5 miles east of Andover, Allegany County.
RECORDS AVAILABLE.--1964-65.
DRAINAGE AREA.--4.24 sq mi.

MAGNITUDE & FREQUENCY OF ANNUAL LOW FLOWS

Period (consecutive days)	Discharge, in cfs, for indicated recurrence intervals, in years		
	2	5	10
1	0.05	0.04	0.03
7	.06	.04	.03
30	.1	.06	.04

ADJUSTED TO STANDARD PERIOD, WATER YEARS 1931-60

Average discharge.-- 4.5 cfs

Duration of daily flow	Discharge, in cfs, which was equaled or exceeded for indicated percent of time								
	50	60	70	80	85	90	95	98	99
	1.6	1.0	0.6	0.4	0.2	0.1	0.07	0.04	0.03

Remarks.--Also a crest-stage partial-record station. No known regulation or diversion.

2204.6. Marsh Creek Tributary near Andover, N.Y.

LOCATION.--Lat 42°11'22", long 77°46'02", on downstream right loose masonry abutment wall of culvert on town road, 0.2 mile upstream from mouth, and 1.9 miles northeast of Andover, Allegany County.
RECORDS AVAILABLE.--1964-65.
DRAINAGE AREA.--1.59 sq mi.

MAGNITUDE & FREQUENCY OF ANNUAL LOW FLOWS

Period (consecutive days)	Discharge, in cfs, for indicated recurrence intervals, in years		
	2	5	10
1	0.01	0	0
7	.01	0	0
30	.02	0.01	0

ADJUSTED TO STANDARD PERIOD, WATER YEARS 1931-60

Average discharge.--1.5 cfs

Duration of daily flow	Discharge, in cfs, which was equaled or exceeded for indicated percent of time								
	50	60	70	80	85	90	95	98	99
	0.4	0.2	0.1	0.06	0.04	0.03	0.01	0	0

Remarks.--Also a crest-stage partial-record station. No known regulation or diversion.

2204.65. Railroad Brook near Alfred, N.Y.

LOCATION.--Lat 42°12'51", long 77°47'47", at bridge on town road, 4 ft from downstream left corner, 0.3 mile west of State Highway 21, 2.0 miles south of Alfred, Allegany County, and 4.9 miles upstream from mouth.
RECORDS AVAILABLE.--1964-65.
DRAINAGE AREA.--1.05 sq mi.

MAGNITUDE & FREQUENCY OF ANNUAL LOW FLOWS

Period (consecutive days)	Discharge, in cfs, for indicated recurrence intervals, in years		
	2	5	10
1	0.02	0.02	0.02
7	.03	.02	.02
30	.04	.03	.02

ADJUSTED TO STANDARD PERIOD, WATER YEARS 1931-60

Average discharge.-- 0.7 cfs

Duration of daily flow	Discharge, in cfs, which was equaled or exceeded for indicated percent of time								
	50	60	70	80	85	90	95	98	99
	0.2	0.1	0.1	0.06	0.05	0.04	0.03	0.02	0.02

Remarks.--Also a crest-stage partial-record station. No known regulation or diversion.

2204.8. Elm Valley Creek near Elm Valley, N.Y.

LOCATION.--Lat 42°11'16", long 77°51'00", at bridge on County Highway 12 (Elm Valley-Alfred Road), 2.6 miles north of Elm Valley, Allegany County, and 3.4 miles upstream from mouth.
RECORDS AVAILABLE.--1955, 1964-65.
DRAINAGE AREA.--4.75 sq mi.

MAGNITUDE & FREQUENCY OF ANNUAL LOW FLOWS

Period (consecutive days)	Discharge, in cfs, for indicated recurrence intervals, in years		
	2	5	10
1	0.04	0.03	0.02
7	.05	.03	.03
30	.08	.05	.04

ADJUSTED TO STANDARD PERIOD, WATER YEARS 1931-60

Average discharge.-- 4.5 cfs

Duration of daily flow	Discharge, in cfs, which was equaled or exceeded for indicated percent of time								
	50	60	70	80	85	90	95	98	99
	0.8	0.4	0.3	0.2	0.1	0.08	0.06	0.04	0.03

Remarks.--Also a crest-stage partial-record station. No known regulation or diversion.

2205. Dyke Creek at Wellsville, N.Y.

LOCATION.--Lat 42°07'14", long 77°56'13", at bridge on Miller Street, at Wellsville, Allegany County, 0.6 mile upstream from mouth, and 1.2 miles downstream from Trapping Brook.
RECORDS AVAILABLE.--1955-60≠, 1964-65.
DRAINAGE AREA.--71.4 sq mi.

MAGNITUDE & FREQUENCY OF ANNUAL LOW FLOWS

Period (consecutive days)	Discharge, in cfs, for indicated recurrence intervals, in years		
	2	5	10
1	2.5	1.9	1.6
7	3.0	2.0	1.8
30	4.5	2.8	2.3

ADJUSTED TO STANDARD PERIOD, WATER YEARS 1931-60

Average discharge.-- 86 cfs

Duration of daily flow	Discharge, in cfs, which was equaled or exceeded for indicated percent of time								
	50	60	70	80	85	90	95	98	99
	36	25	16	8.4	6.3	4.5	3.0	2.2	1.9

Remarks.-- (≠ Operated as a continuous-record gaging station.) Also a crest-stage partial-record station. No known regulation or diversion.

2212. Brimmer Brook near Wellsville, N.Y.

LOCATION.--Lat 42°07'30", long 77°58'43", at bridge on town road, 1.1 miles upstream from mouth, and 1.8 miles west of Wellsville, Allegany County.
RECORDS AVAILABLE.--1955, 1964-65.
DRAINAGE AREA.--

MAGNITUDE & FREQUENCY OF ANNUAL LOW FLOWS

Period (consecutive days)	Discharge, in cfs, for indicated recurrence intervals, in years		
	2	5	10
1	0.4	0.3	0.3
7	.5	.3	.3
30	.7	.4	.4

ADJUSTED TO STANDARD PERIOD, WATER YEARS 1931-60

Average discharge.--11 cfs

Duration of daily flow	Discharge, in cfs, which was equaled or exceeded for indicated percent of time								
	50	60	70	80	85	90	95	98	99
	4.2	2.9	2.0	1.4	1.1	0.8	0.5	0.4	0.3

Remarks.--Stream receives some amount of oil field wastes upstream. No known regulation or diversion.

2215.1 Vandermark Creek near Scio, N.Y.

LOCATION.--Lat 42°10'02", long 77°57'31", at bridge on County Highway 10, 1.1 miles east of Scio, Allegany County, and 1.3 miles upstream from mouth.
RECORDS AVAILABLE.--1954-55, 1964-65.
DRAINAGE AREA.--

MAGNITUDE & FREQUENCY OF ANNUAL LOW FLOWS

Period (consecutive days)	Discharge, in cfs, for indicated recurrence intervals, in years		
	2	5	10
1	0.3	0.2	0.2
7	.4	.3	.2
30	.7	.4	.3

ADJUSTED TO STANDARD PERIOD, WATER YEARS 1931-60

Average discharge.--25 cfs

Duration of daily flow	Discharge, in cfs, which was equaled or exceeded for indicated percent of time								
	50	60	70	80	85	90	95	98	99
	9.0	5.7	3.4	1.7	1.2	0.8	0.4	0.3	0.2

Remarks.--No known regulation or diversion.

2215.2. Knight Creek at Scio. N.Y.

LOCATION.--Lat 42°10'15", long 77°59'17", at bridge on county road, 0.4 mile upstream from mouth, and 0.5 mile west of Scio, Allegany County.
RECORDS AVAILABLE.--1954-55, 1964-65.
DRAINAGE AREA.--

MAGNITUDE & FREQUENCY OF ANNUAL LOW FLOWS

Period (consecutive days)	Discharge, in cfs, for indicated recurrence intervals, in years		
	2	5	10
1	1.6	1.3	1.2
7	1.8	1.3	1.2
30	2.2	1.7	1.4

ADJUSTED TO STANDARD PERIOD, WATER YEARS 1931-60

Average discharge.--24 cfs

Duration of daily flow	Discharge, in cfs, which was equaled or exceeded for indicated percent of time								
	50	60	70	80	85	90	95	98	99
	9.6	6.8	5.0	3.6	3.0	2.4	1.8	1.4	1.3

Remarks.--Stream receives some amount of oil field wastes upstream. No known regulation or diversion.

2215.3. Gordon Brook at Scio, N.Y.

LOCATION.--Lat 42°10'44", long 77°59'37", at bridge on town highway, 0.7 mile upstream from mouth, and 0.9 mile northwest of Scio, Allegany County, N.Y.
RECORDS AVAILABLE.--1964-65.
DRAINAGE AREA.--

MAGNITUDE & FREQUENCY OF ANNUAL LOW FLOWS

Period (consecutive days)	Discharge, in cfs, for indicated recurrence intervals, in years		
	2	5	10
1	0.1	0.06	0.04
7	.1	.07	.05
30	.3	.1	.08

ADJUSTED TO STANDARD PERIOD, WATER YEARS 1931-60

Average discharge.--10 cfs

Duration of daily flow	Discharge, in cfs, which was equaled or exceeded for indicated percent of time								
	50	60	70	80	85	90	95	98	99
	4.0	2.7	1.7	1.0	0.6	0.3	0.2	0.08	0.06

Remarks.--Operated as a miscellaneous measuring site. No known regulation or diversion.

2215.6. Phillips Creek near Belmont, N.Y.

LOCATION.--Lat 42°14'23", long 78°00'54", at old bridge site on town road, 0.1 mile upstream from unnamed tributary, 1.4 miles upstream from mouth, and 1.6 miles northeast of Belmont, Allegany County.
RECORDS AVAILABLE.--1964-65.
DRAINAGE AREA.--

MAGNITUDE & FREQUENCY OF ANNUAL LOW FLOWS

Period (consecutive days)	Discharge, in cfs, for indicated recurrence intervals, in years		
	2	5	10
1	1.2	1.0	0.9
7	1.4	1.1	1.0
30	1.8	1.3	1.1

ADJUSTED TO STANDARD PERIOD, WATER YEARS 1931-60

Average discharge.--25 cfs

Duration of daily flow	Discharge, in cfs, which was equaled or exceeded for indicated percent of time								
	50	60	70	80	85	90	95	98	99
	8.8	6.0	4.2	2.9	2.4	1.9	1.4	1.1	1.0

Remarks.--No known regulation or diversion.

2216.5. Black Creek at Bennetts, N.Y.

LOCATION.--Lat 42°19'19", long 77°56'32", at bridge on State Highway 408, 0.1 mile east of Bennetts, Allegany County, and 1.6 miles upstream from mouth.
RECORDS AVAILABLE.--1964-65.
DRAINAGE AREA.--32.8 sq mi.

MAGNITUDE & FREQUENCY OF ANNUAL LOW FLOWS

Period (consecutive days)	Discharge, in cfs, for indicated recurrence intervals, in years		
	2	5	10
1	0.3	0.3	0.2
7	.4	.3	.2
30	.6	.4	.3

Remarks.--No known regulation or diversion.

ADJUSTED TO STANDARD PERIOD, WATER YEARS 1931-60

Average discharge.--25 cfs

Duration of daily flow	Discharge, in cfs, which was equaled or exceeded for indicated percent of time								
	50	60	70	80	85	90	95	98	99
	16	11	6.6	1.5	0.9	0.6	0.4	0.3	0.2

2217. Angelica Creek near Angelica, N.Y.

LOCATION.--Lat 42°18'38", long 78°02'16", at bridge on State Highway 408, 1.2 miles west of Angelica, Allegany County.

RECORDS AVAILABLE.--1954-55, 1957-62.
DRAINAGE AREA.--61.3 sq mi.

MAGNITUDE & FREQUENCY OF ANNUAL LOW FLOWS

Period (consecutive days)	Discharge, in cfs, for indicated recurrence intervals, in years		
	2	5	10
1	1.0	0.3	0.1
7	1.2	.4	.2
30	2.0	.8	.4

Remarks.--No known regulation or diversion.

ADJUSTED TO STANDARD PERIOD, WATER YEARS 1931-60

Average discharge.--70 cfs

Duration of daily flow	Discharge, in cfs, which was equaled or exceeded for indicated percent of time								
	50	60	70	80	85	90	95	98	99
	23	14	8.4	4.8	3.4	2.2	1.2	0.6	0.4

2217.1. Baker Creek near Angelica, N.Y.

LOCATION.--Lat 42°18'31", long 78°02'38", at bridge on State Highway 408, 0.3 mile upstream from mouth, and 1.3 miles west of Angelica, Allegany County.
RECORDS AVAILABLE.--1955, 1964-65.
DRAINAGE AREA.--21.9 sq mi.

MAGNITUDE & FREQUENCY OF ANNUAL LOW FLOWS

Period (consecutive days)	Discharge, in cfs, for indicated recurrence intervals, in years		
	2	5	10
1	0.4	0.3	0.3
7	.5	.3	.3
30	.6	.4	.4

Remarks.--No known regulation or diversion.

ADJUSTED TO STANDARD PERIOD, WATER YEARS 1931-60

Average discharge.--14 cfs

Duration of daily flow	Discharge, in cfs, which was equaled or exceeded for indicated percent of time								
	50	60	70	80	85	90	95	98	99
	5.5	3.6	2.1	1.2	0.9	0.6	0.5	0.4	0.3

2217.6. White Creek near Belfast, N.Y.

LOCATION.--Lat 42°18'53, long 78°06'28", at bridge on town road 1.1 miles upstream from mouth, and 1.9 miles south of Belfast, Allegany County.
RECORDS AVAILABLE.--1964-65.
DRAINAGE AREA.--

MAGNITUDE & FREQUENCY OF ANNUAL LOW FLOWS

Period (consecutive days)	Discharge, in cfs, for indicated recurrence intervals, in years		
	2	5	10
1	0.1	0.09	0.07
7	.2	.1	.08
30	.3	.2	.1

Remarks.--No known regulation or diversion.

ADJUSTED TO STANDARD PERIOD, WATER YEARS 1931-60

Average discharge.--8.0 cfs

Duration of daily flow	Discharge, in cfs, which was equaled or exceeded for indicated percent of time								
	50	60	70	80	85	90	95	98	99
	2.8	1.7	1.1	0.7	0.5	0.3	0.2	0.1	0.08

2218. Black Creek at Rockville, N.Y.

LOCATION.--Lat 42°18'08", long 78°09'49", at bridge on State Highway 305, at Rockville, Allegany County.

RECORDS AVAILABLE.--1957-62, 1964-65.
DRAINAGE AREA.--21.3 sq mi.

MAGNITUDE & FREQUENCY OF ANNUAL LOW FLOWS

Period (consecutive days)	Discharge, in cfs, for indicated recurrence intervals, in years		
	2	5	10
1	0.2	0.1	0.1
7	.2	.1	.1
30	.3	.2	.2

Remarks.--No known regulation or diversion.

ADJUSTED TO STANDARD PERIOD, WATER YEARS 1931-60

Average discharge.--14 cfs

Duration of daily flow	Discharge, in cfs, which was equaled or exceeded for indicated percent of time								
	50	60	70	80	85	90	95	98	99
	5.2	3.3	2.0	1.1	0.7	0.4	0.2	0.1	0.1

2218.1. Wigwam Creek at Belfast, N.Y.

LOCATION.-- Lat 42°20'04", long 78°05'54", at bridge on County Highway 26, 0.5 mile upstream from mouth, and 1.0 mile southeast of Belfast, Allegany County.
RECORDS AVAILABLE.-- 1955, 1964-65.
DRAINAGE AREA.--

MAGNITUDE & FREQUENCY OF ANNUAL LOW FLOWS

Period (consecutive days)	Discharge, in cfs, for indicated recurrence intervals, in years		
	2	5	10
1	0.2	0.1	0.08
7	.2	.1	.1
30	.4	.2	.1

Remarks.-- No known regulation or diversion.

ADJUSTED TO STANDARD PERIOD, WATER YEARS 1931-60

Average discharge.-- 6.5 cfs

Duration of daily flow	Discharge, in cfs, which was equaled or exceeded for indicated percent of time								
	50	60	70	80	85	90	95	98	99
	3.1	2.2	1.5	0.9	0.6	0.4	0.2	0.1	0.1

2218.3. Crawford Creek at Oramel, N.Y.

LOCATION.-- Lat 42°21'37", long 78°08'58", at bridge on town road, 0.8 mile west of Oramel, Allegany County, and 1.2 miles upstream from mouth.
RECORDS AVAILABLE.-- 1955, 1964-65.
DRAINAGE AREA.--

MAGNITUDE & FREQUENCY OF ANNUAL LOW FLOWS

Period (consecutive days)	Discharge, in cfs, for indicated recurrence intervals, in years		
	2	5	10
1	0.3	0.2	0.2
7	.4	.2	.2
30	.5	.3	.2

Remarks.-- No known regulation or diversion.

ADJUSTED TO STANDARD PERIOD, WATER YEARS 1931-60

Average discharge.--9.0 cfs

Duration of daily flow	Discharge, in cfs, which was equaled or exceeded for indicated percent of time								
	50	60	70	80	85	90	95	98	99
	3.6	2.3	1.5	0.9	0.7	0.5	0.4	0.2	0.2

2225.3. Cold Creek at Hume, N.Y.

LOCATION.-- Lat 42°28'23", long 78°08'12", at bridge on County Highway 23, at Hume, Allegany County, and 1.8 miles upstream from mouth.
RECORDS AVAILABLE.-- 1955, 1964-65.
DRAINAGE AREA.--

MAGNITUDE & FREQUENCY OF ANNUAL LOW FLOWS

Period (consecutive days)	Discharge, in cfs, for indicated recurrence intervals, in years		
	2	5	10
1	2.6	2.2	1.9
7	3.0	2.3	2.1
30	3.8	2.6	2.4

Remarks.-- No known regulation or diversion.

ADJUSTED TO STANDARD PERIOD, WATER YEARS 1931-60

Average discharge.--50 cfs

Duration of daily flow	Discharge, in cfs, which was equaled or exceeded for indicated percent of time								
	50	60	70	80	85	90	95	98	99
	19	13	9.0	6.3	5.1	4.0	3.0	2.4	2.1

2225.35. Rush Creek near Fillmore, N.Y.

LOCATION.-- Lat 42°26'44", long 78°04'50", at bridge on town road, 1.8 miles upstream from mouth, and 2.2 miles southeast of Fillmore, Allegany County.
RECORDS AVAILABLE.-- 1964-65.
DRAINAGE AREA.--

MAGNITUDE & FREQUENCY OF ANNUAL LOW FLOWS

Period (consecutive days)	Discharge, in cfs, for indicated recurrence intervals, in years		
	2	5	10
1	0.5	0.3	0.3
7	.5	.4	.3
30	.8	.5	.4

Remarks.--Operated as a miscellaneous measuring site. No known regulation or diversion.

ADJUSTED TO STANDARD PERIOD, WATER YEARS 1931-60

Average discharge.--about 15 cfs

Duration of daily flow	Discharge, in cfs, which was equaled or exceeded for indicated percent of time								
	50	60	70	80	85	90	95	98	99
	6.0	4.0	2.5	1.6	1.2	0.9	0.6	0.4	0.4

2225.4. Rush Creek at Fillmore, N.Y.

LOCATION.-- Lat 42°27'54", long 78°05'47", at bridge on County Highway 27B, 0.2 mile upstream from mouth, and 0.9 mile east of Fillmore, Allegany County.
RECORDS AVAILABLE.-- 1955, 1964-65.
DRAINAGE AREA.--

MAGNITUDE & FREQUENCY OF ANNUAL LOW FLOWS

Period (consecutive days)	Discharge, in cfs, for indicated recurrence intervals, in years		
	2	5	10
1	0.2	0.01	0
7	.3	.02	0
30	.9	.2	.1

Remarks.-- No known regulation or diversion.

ADJUSTED TO STANDARD PERIOD, WATER YEARS 1931-60

Average discharge.-- 15 cfs

Duration of daily flow	Discharge, in cfs, which was equaled or exceeded for indicated percent of time								
	50	60	70	80	85	90	95	98	99
	10	7.0	4.5	2.5	1.7	1.0	0.4	0.1	0

2226. Wiscoy Creek at Bliss, N.Y.

LOCATION.--Lat 42°34'59", long 78°14'16", at bridge on county road, 0.1 mile north of State Highway 39, and 0.6 mile east of Bliss.
RECORDS AVAILABLE.--1961-62, 1964-65.
DRAINAGE AREA.--21.8 sq mi.

MAGNITUDE & FREQUENCY OF ANNUAL LOW FLOWS

Period (consecutive days)	Discharge, in cfs, for indicated recurrence intervals, in years		
	2	5	10
1	6.6	5.6	5.0
7	6.9	5.6	5.0
30	8.2	6.5	5.5

ADJUSTED TO STANDARD PERIOD, WATER YEARS 1931-60

Average discharge.--39 cfs

Duration of daily flow	Discharge, in cfs, which was equaled or exceeded for indicated percent of time								
	50	60	70	80	85	90	95	98	99
	23	18	15	12	10	9.0	7.4	6.2	5.6

Remarks.-- Also a crest-stage partial-record station. Some slight diversion for irrigation upstream.

2226.8. Trout Brook at Pike Corners, N.Y.

LOCATION.-- Lat 42°34'17", long 78°10'19", at bridge on State Highway 39, 0.03 mile upstream from mouth, and 0.5 mile southeast of Pike Corners, Wyoming County.
RECORDS AVAILABLE.-- 1964-65.
DRAINAGE AREA.--

MAGNITUDE & FREQUENCY OF ANNUAL LOW FLOWS

Period (consecutive days)	Discharge, in cfs, for indicated recurrence intervals, in years		
	2	5	10
1	3.0	2.5	2.3
7	3.3	2.5	2.3
30	4.0	3.0	2.6

ADJUSTED TO STANDARD PERIOD, WATER YEARS 1931-60

Average discharge.--19 cfs

Duration of daily flow	Discharge, in cfs, which was equaled or exceeded for indicated percent of time								
	50	60	70	80	85	90	95	98	99
	11	9.0	7.0	5.6	5.0	4.2	3.5	2.9	2.6

Remarks.--No known regulation or diversion.

2227. Wiscoy Creek at Pike, N.Y.

LOCATION.-- Lat 42°33'19", long 78°09'19", at bridge on Allegany Road at Pike, Wyoming County.

RECORDS AVAILABLE.-- 1957-61.
DRAINAGE AREA.-- 43.9 sq mi.

MAGNITUDE & FREQUENCY OF ANNUAL LOW FLOWS

Period (consecutive days)	Discharge, in cfs, for indicated recurrence intervals, in years		
	2	5	10
1	11	7.5	6.0
7	12	8.5	7.0
30	15	10	9.0

ADJUSTED TO STANDARD PERIOD, WATER YEARS 1931-60

Average discharge.-- 60 cfs

Duration of daily flow	Discharge, in cfs, which was equaled or exceeded for indicated percent of time								
	50	60	70	80	85	90	95	98	99
	36	30	24	20	18	15	12	9.5	8.0

Remarks.-- Some slight diversion for irrigation upstream.

2234. Wolf Creek near Castile, N.Y.

LOCATION.-- Lat 42°36'55", long 78°00'45", at bridge on Letchworth State Park road, 0.3 mile upstream from mouth, and 2.5 miles southeast of Castile, Wyoming County.
RECORDS AVAILABLE.-- 1959, 1964-65.
DRAINAGE AREA.--

MAGNITUDE & FREQUENCY OF ANNUAL LOW FLOWS

Period (consecutive days)	Discharge, in cfs, for indicated recurrence intervals, in years		
	2	5	10
1	0.9	0.7	0.5
7	.9	.7	.5
30	1.5	1.0	.8

ADJUSTED TO STANDARD PERIOD, WATER YEARS 1931-60

Average discharge.--11 cfs

Duration of daily flow	Discharge, in cfs, which was equaled or exceeded for indicated percent of time								
	50	60	70	80	85	90	95	98	99
	6.0	5.0	3.7	2.7	2.2	1.7	1.2	0.8	0.7

Remarks.-- Discharges from salt works upstream probably effect flow somewhat at lower stages.

2245.5. Ewart Creek at Swain, N.Y.

LOCATION.--Lat 42°28'40", long 77°51'18", at bridge on town road at Swain, Allegany County, and 0.3 mile upstream from mouth.
RECORDS AVAILABLE.--1964-65.
DRAINAGE AREA.--3.90 sq mi.

MAGNITUDE & FREQUENCY OF ANNUAL LOW FLOWS

Period (consecutive days)	Discharge, in cfs, for indicated recurrence intervals, in years		
	2	5	10
1	0.02	0	0
7	.02	.01	0
30	.05	.02	.01

ADJUSTED TO STANDARD PERIOD, WATER YEARS 1931-60

Average discharge.--3.0 cfs

Duration of daily flow	Discharge, in cfs, which was equaled or exceeded for indicated percent of time								
	50	60	70	80	85	90	95	98	99
	0.9	0.6	0.3	0.2	0.1	0.06	0.03	0.01	0

Remarks.-- Also a crest-stage partial-record station. No known regulation or diversion.

2247. Sugar Creek near Ossian, N.Y.

LOCATION.-- Lat 42°30'52", long 77°48'12", on right bank 300 ft downstream from bridge on Linzy Road, 1.3 miles southwest of Ossian, Livingston County, and 5.1 miles upstream from mouth.
RECORDS AVAILABLE.-- 1964-65.
DRAINAGE AREA.-- 9.83 sq mi.

MAGNITUDE & FREQUENCY OF ANNUAL LOW FLOWS

Period (consecutive days)	Discharge, in cfs, for indicated recurrence intervals, in years		
	2	5	10
1	0.2	0.1	0.1
7	.2	.2	.1
30	.4	.2	.2

ADJUSTED TO STANDARD PERIOD, WATER YEARS 1931-60

Average discharge.--8.5 cfs

Duration of daily flow	Discharge, in cfs, which was equaled or exceeded for indicated percent of time								
	50	60	70	80	85	90	95	98	99
	3.0	2.0	1.2	0.8	0.6	0.4	0.3	0.2	0.1

Remarks.-- Also a crest-stage partial-record station. No known regulation or diversion.

2248. Stony Brook at South Dansville, N.Y.

LOCATION.-- Lat 42°28'14", long 77°39'10", on downstream left timber wingwall of bridge on town road at South Dansville, Steuben County, and 6.1 miles upstream from mouth.
RECORDS AVAILABLE.-- 1964-65.
DRAINAGE AREA.-- 2.23 sq mi.

MAGNITUDE & FREQUENCY OF ANNUAL LOW FLOWS

Period (consecutive days)	Discharge, in cfs, for indicated recurrence intervals, in years		
	2	5	10
1	0.05	0.04	0.04
7	.06	.04	.04
30	.08	.06	.05

ADJUSTED TO STANDARD PERIOD, WATER YEARS 1931-60

Average discharge.--2.0 cfs

Duration of daily flow	Discharge, in cfs, which was equaled or exceeded for indicated percent of time								
	50	60	70	80	85	90	95	98	99
	0.6	0.4	0.2	0.1	0.1	0.09	0.06	0.05	0.04

Remarks.-- Also a crest-stage partial-record station. No known regulation or diversion.

2248.1. Sponable Creek near South Dansville, N.Y.

LOCATION.-- Lat 42°30'04", long 77°37'58", at culvert on town road, 2.5 miles north of South Dansville, Steuben County, and 2.7 miles upstream from mouth.
RECORDS AVAILABLE.-- 1964-65.
DRAINAGE AREA.-- 0.69 sq mi.

MAGNITUDE & FREQUENCY OF ANNUAL LOW FLOWS

Period (consecutive days)	Discharge, in cfs, for indicated recurrence intervals, in years		
	2	5	10
1	0.05	0.04	0.04
7	.06	.04	.04
30	.07	.05	.04

ADJUSTED TO STANDARD PERIOD, WATER YEARS 1931-60

Average discharge.-- 0.6 cfs

Duration of daily flow	Discharge, in cfs, which was equaled or exceeded for indicated percent of time								
	50	60	70	80	85	90	95	98	99
	0.2	0.2	0.1	0.1	0.09	0.07	0.06	0.05	0.04

Remarks.-- Also a crest-stage partial-record station. No known regulation or diversion.

2249. Mill Creek at Patchinville, N.Y.

LOCATION.--Lat 42°31'13", long 77°35'06", at bridge on Ellinger Road, 0.1 mile east of State Highway 21, 0.8 mile south of Patchinville, Steuben County, 3.3 miles south of Wayland, and 9.1 miles upstream from mouth.
RECORDS AVAILABLE.-- 1964-65
DRAINAGE AREA.-- 5.00 sq mi.

MAGNITUDE & FREQUENCY OF ANNUAL LOW FLOWS

Period (consecutive days)	Discharge, in cfs, for indicated recurrence intervals, in years		
	2	5	10
1	1.2	0.9	0.8
7	1.4	1.0	.9
30	1.6	1.2	1.0

ADJUSTED TO STANDARD PERIOD, WATER YEARS 1931-60

Average discharge.-- 5.3 cfs

Duration of daily flow	Discharge, in cfs, which was equaled or exceeded for indicated percent of time								
	50	60	70	80	85	90	95	98	99
	3.5	3.0	2.6	2.2	2.0	1.7	1.4	1.1	0.9

Remarks.-- Also a crest-stage partial-record station. No known regulation or diversion.

2256. Bradner Creek at Woodsville, N.Y.

LOCATION.-- Lat 42°34'49", long 77°44'20", at bridge on old state highway, about 150 ft upstream from State Highway 36, 0.4 mile northwest of Woodsville, Livingston County, 2.7 miles northwest of Dansville, and 8.5 miles upstream from mouth.
RECORDS AVAILABLE.-- 1964-65.
DRAINAGE AREA.-- 7.45 sq mi.

MAGNITUDE & FREQUENCY OF ANNUAL LOW FLOWS

Period (consecutive days)	Discharge, in cfs, for indicated recurrence intervals, in years		
	2	5	10
1	0.9	0.8	0.8
7	1.0	.8	.8
30	1.3	.9	.8

ADJUSTED TO STANDARD PERIOD, WATER YEARS 1931-60

Average discharge.-- 8.0 cfs

Duration of daily flow	Discharge, in cfs, which was equaled or exceeded for indicated percent of time								
	50	60	70	80	85	90	95	98	99
	4.8	3.8	3.0	2.2	1.8	1.4	1.1	0.9	0.8

Remarks.-- No known regulation or diversion.

2260. Keshequa Creek at Craig Colony, Sonyea, N.Y.

LOCATION.-- Lat 42°40'53", long 77°49'45", at bridge at Craig Colony, Sonyea, Livingston County.

RECORDS AVAILABLE.-- 1910-12≠, 1917-32≠, 1954, 1957-62, 1964-65.
DRAINAGE AREA.-- 69.1 sq mi.

MAGNITUDE & FREQUENCY OF ANNUAL LOW FLOWS

Period (consecutive days)	Discharge, in cfs, for indicated recurrence intervals, in years		
	2	5	10
1	1.0	0.5	0.2
7	1.4	.7	.5
30	2.3	1.4	.8

ADJUSTED TO STANDARD PERIOD, WATER YEARS 1931-60

Average discharge.-- 50 cfs

Duration of daily flow	Discharge, in cfs, which was equaled or exceeded for indicated percent of time								
	50	60	70	80	85	90	95	98	99
	18	12	8.6	5.4	4.0	2.9	1.7	1.0	0.6

Remarks.--≠ Operated as a continuous gaging station. Craig Colony diverts about 0.5 mgd immediately downstream from site.

2276. Beards Creek at Cuylerville, N.Y.

LOCATION.-- Lat 42°46'36", long 77°51'38", at bridge on U.S. Highway 20A and State Highway 39, 0.6 mile east of Cuylerville, Livingston County, and 0.9 mile upstream from mouth.
RECORDS AVAILABLE.--1964-65.
DRAINAGE AREA.--

MAGNITUDE & FREQUENCY OF ANNUAL LOW FLOWS

Period (consecutive days)	Discharge, in cfs, for indicated recurrence intervals, in years		
	2	5	10
1	0	0	0
7	0	0	0
30	.01	0	0

ADJUSTED TO STANDARD PERIOD, WATER YEARS 1931-60

Average discharge.-- 8.0 cfs

Duration of daily flow	Discharge, in cfs, which was equaled or exceeded for indicated percent of time								
	50	60	70	80	85	90	95	98	99
	2.5	1.5	0.7	0.2	0.1	0	0	0	0

Remarks.-- No known regulation or diversion.

2276.5. Jaycox Creek near Geneseo, N.Y.

LOCATION.--Lat 42°50'06", long 77°48'44", at bridge on Nations Road, 1.5 miles upstream from mouth, and 1.7 miles north of village line of Geneseo, Livingston County.
RECORDS AVAILABLE.--1964-65.
DRAINAGE AREA.--

MAGNITUDE & FREQUENCY OF ANNUAL LOW FLOWS

Period (consecutive days)	Discharge, in cfs, for indicated recurrence intervals, in years		
	2	5	10
1	0.02	0.02	0.01
7	.02	.02	.02
30	.03	.02	.02

ADJUSTED TO STANDARD PERIOD, WATER YEARS 1931-60

Average discharge.-- 0.7 cfs

Duration of daily flow	Discharge, in cfs, which was equaled or exceeded for indicated percent of time								
	50	60	70	80	85	90	95	98	99
	0.2	0.1	0.08	0.05	0.04	0.03	0.02	0.02	0.02

Remarks.--No known regulation or diversion.

2279. Christie Creek near Canawaugus, N.Y.

LOCATION.--Lat 42°54'40", long 77°47'19", at culvert on River Road, 0.2 mile upstream from mouth and 1.2 miles south of Canawaugus, Livingston County.
RECORDS AVAILABLE.--1964-65.
DRAINAGE AREA.--

MAGNITUDE & FREQUENCY OF ANNUAL LOW FLOWS

Period (consecutive days)	Discharge, in cfs, for indicated recurrence intervals, in years		
	2	5	10
1	0.2	0.1	0.1
7	.2	.2	.1
30	.4	.2	.2

ADJUSTED TO STANDARD PERIOD, WATER YEARS 1931-60

Average discharge.-- 5.0 cfs

Duration of daily flow	Discharge, in cfs, which was equaled or exceeded for indicated percent of time								
	50	60	70	80	85	90	95	98	99
	2.5	1.8	1.2	0.8	0.7	0.5	0.3	0.2	0.1

Remarks.-- No known regulation or diversion.

2285.2. White Creek at Canawaugus, N.Y.

LOCATION.-- Lat 42°55'53", long 77°46'51", at culvert on River Road, 0.2 mile north of Canawaugus, Livingston County, and 0.5 mile upstream from mouth.
RECORDS AVAILABLE.-- 1964-65.
DRAINAGE AREA.--

MAGNITUDE & FREQUENCY OF ANNUAL LOW FLOWS

Period (consecutive days)	Discharge, in cfs, for indicated recurrence intervals, in years		
	2	5	10
1	1.3	1.2	1.2
7	1.3	1.2	1.2
30	1.5	1.3	1.2

ADJUSTED TO STANDARD PERIOD, WATER YEARS 1931-60

Average discharge.-- 5.5 cfs

Duration of daily flow	Discharge, in cfs, which was equaled or exceeded for indicated percent of time								
	50	60	70	80	85	90	95	98	99
	3.2	2.7	2.2	1.9	1.7	1.6	1.4	1.3	1.2

Remarks.-- No known regulation or diversion.

2285.5. Dugan Creek at Maxwell, N.Y.

LOCATION.-- Lat 42°58'25", long 77°46'22", at bridge on County Highway 53, 0.2 mile south of Maxwell, Livingston County, and 3.6 miles upstream from mouth.
RECORDS AVAILABLE.-- 1964-65.
DRAINAGE AREA.--

MAGNITUDE & FREQUENCY OF ANNUAL LOW FLOWS

Period (consecutive days)	Discharge, in cfs, for indicated recurrence intervals, in years		
	2	5	10
1	0.8	0.5	0.4
7	.9	.6	.5
30	1.4	.9	.7

Remarks.-- No known regulation or diversion.

ADJUSTED TO STANDARD PERIOD, WATER YEARS 1931-60

Average discharge.-- 5.7 cfs

Duration of daily flow	Discharge, in cfs, which was equaled or exceeded for indicated percent of time								
	50	60	70	80	85	90	95	98	99
	4.1	3.4	2.8	2.2	1.9	1.5	1.1	0.8	0.6

2288.55. Mill Creek at Honeoye Park, N.Y.

LOCATION.-- Lat 42°47'09", long 77°29'57", at bridge on East Lake Road, 0.6 mile northeast of Honeoye Park, Ontario County, and 0.9 mile upstream from mouth.
RECORDS AVAILABLE.-- 1964-65.
DRAINAGE AREA.--

MAGNITUDE & FREQUENCY OF ANNUAL LOW FLOWS

Period (consecutive days)	Discharge, in cfs, for indicated recurrence intervals, in years		
	2	5	10
1	0.7	0.6	0.5
7	.7	.6	.5
30	.9	.7	.6

Remarks.-- No known regulation or diversion.

ADJUSTED TO STANDARD PERIOD, WATER YEARS 1931-60

Average discharge.--9.0 cfs

Duration of daily flow	Discharge, in cfs, which was equaled or exceeded for indicated percent of time								
	50	60	70	80	85	90	95	98	99
	4.0	2.8	2.0	1.5	1.2	1.0	0.8	0.6	0.6

2293.3. Bebee Creek at Idaho, N.Y.

LOCATION.-- Lat 42°51'38", long 77°32'18", at bridge on South Road, 0.9 mile east of Idaho, Livingston County, N.Y., and 1.3 miles upstream from mouth.
RECORDS AVAILABLE.-- 1964-65.
DRAINAGE AREA.--

MAGNITUDE & FREQUENCY OF ANNUAL LOW FLOWS

Period (consecutive days)	Discharge, in cfs, for indicated recurrence intervals, in years		
	2	5	10
1	0.02	0.02	0.01
7	.02	.02	.02
30	.04	.03	.02

Remarks.-- Operated as a miscellaneous measuring site. No known regulation or diversion.

ADJUSTED TO STANDARD PERIOD, WATER YEARS 1931-60

Average discharge.-- 6.0 cfs

Duration of daily flow	Discharge, in cfs, which was equaled or exceeded for indicated percent of time								
	50	60	70	80	85	90	95	98	99
	3.0	1.3	0.5	0.1	0.08	0.05	0.03	0.02	0.02

2297. Spring Brook at Moran Corner, N.Y.

LOCATION.-- Lat 42°57'36", long 77°37'11", at bridge on state highway, 0.03 mile east of State Highway 15A at Moran Corner, Monroe County, and 0.4 mile upstream from mouth.
RECORDS AVAILABLE.-- 1964-65.
DRAINAGE AREA.--

MAGNITUDE & FREQUENCY OF ANNUAL LOW FLOWS

Period (consecutive days)	Discharge, in cfs, for indicated recurrence intervals, in years		
	2	5	10
1	0.2	0.2	0.2
7	.3	.2	.2
30	.4	.2	.2

Remarks.-- No known regulation or diversion.

ADJUSTED TO STANDARD PERIOD, WATER YEARS 1931-60

Average discharge.-- 8.0 cfs

Duration of daily flow	Discharge, in cfs, which was equaled or exceeded for indicated percent of time								
	50	60	70	80	85	90	95	98	99
	2.3	1.4	0.9	0.6	0.5	0.4	0.3	0.2	0.2

2300.5. Honeoye Creek Tributary near Rush, N.Y.

LOCATION.-- Lat 42°59'09", long 77°39'54", at bridge on Rush Road, 0.2 mile upstream from mouth, and 1.1 miles southwest of Rush, Monroe County.
RECORDS AVAILABLE.--1964-65.
DRAINAGE AREA.--

MAGNITUDE & FREQUENCY OF ANNUAL LOW FLOWS

Period (consecutive days)	Discharge, in cfs, for indicated recurrence intervals, in years		
	2	5	10
1	0.6	0.6	0.5
7	.7	.6	.5
30	1.0	.7	.6

Remarks.-- No known regulation or diversion.

ADJUSTED TO STANDARD PERIOD, WATER YEARS 1931-60

Average discharge.-- 12 cfs

Duration of daily flow	Discharge, in cfs, which was equaled or exceeded for indicated percent of time								
	50	60	70	80	85	90	95	98	99
	4.6	3.2	2.2	1.6	1.3	1.0	0.8	0.6	0.6

2303.1. Warner Creek at Rock Glen, N.Y.

LOCATION.-- Lat 42°41'04", long 78°06'05", at bridge on Evans Road, 0.9 mile east of Rock Glen, Wyoming County, and 1.2 miles upstream from mouth.
RECORDS AVAILABLE.-- 1964-65.
DRAINAGE AREA.--

MAGNITUDE & FREQUENCY OF ANNUAL LOW FLOWS

Period (consecutive days)	Discharge, in cfs, for indicated recurrence intervals, in years		
	2	5	10
1	0.2	0.1	0.1
7	.2	.1	.1
30	.3	.2	.2

Remarks.-- No known regulation or diversion.

ADJUSTED TO STANDARD PERIOD, WATER YEARS 1931-60

Average discharge.-- 4.5 cfs

Duration of daily flow	Discharge, in cfs, which was equaled or exceeded for indicated percent of time								
	50	60	70	80	85	90	95	98	99
	2.0	1.4	0.9	0.6	0.4	0.3	0.2	0.2	0.1

2303.6. Stony Creek at Warsaw, N.Y.

LOCATION.--Lat 42°44'00", long 78°08'16", at bridge on Warsaw Street at Warsaw, Wyoming County, and 0.4 mile upstream from mouth.
RECORDS AVAILABLE.-- 1964-65.
DRAINAGE AREA.--

MAGNITUDE & FREQUENCY OF ANNUAL LOW FLOWS

Period (consecutive days)	Discharge, in cfs, for indicated recurrence intervals, in years		
	2	5	10
1	0.1	0.01	0
7	.1	.04	.01
30	.3	.1	.04

Remarks.-- No known regulation or diversion.

ADJUSTED TO STANDARD PERIOD, WATER YEARS 1931-60

Average discharge.-- 7.5 cfs

Duration of daily flow	Discharge, in cfs, which was equaled or exceeded for indicated percent of time								
	50	60	70	80	85	90	95	98	99
	3.4	2.2	1.4	0.8	0.6	0.4	0.2	0.06	0.02

2304.1. Pearl Creek at Pearl Creek, N.Y.

LOCATION.--Lat 42°50'55", long 78°02'36", at bridge on State Highway 19, 0.2 mile east of Pearl Creek, Wyoming County, and 1.0 mile upstream from mouth.
RECORDS AVAILABLE.-- 1964-65.
DRAINAGE AREA.--

MAGNITUDE & FREQUENCY OF ANNUAL LOW FLOWS

Period (consecutive days)	Discharge, in cfs, for indicated recurrence intervals, in years		
	2	5	10
1	0.08	0.06	0.05
7	.08	.06	.05
30	.1	.09	.06

Remarks.--No known regulation or diversion.

ADJUSTED TO STANDARD PERIOD, WATER YEARS 1931-60

Average discharge.-- 6.0 cfs

Duration of daily flow	Discharge, in cfs, which was equaled or exceeded for indicated percent of time								
	50	60	70	80	85	90	95	98	99
	2.6	1.7	1.0	0.5	0.3	0.2	0.1	0.07	0.06

2304.9. Spring Creek at Mumford, N.Y.

LOCATION.-- Lat 42°59'14", long 77°51'44", at Baltimore and Ohio RR bridge, 0.4 mile south of Mumford, Monroe County, and 0.7 mile upstream from mouth.
RECORDS AVAILABLE.-- 1964-65.
DRAINAGE AREA.--

MAGNITUDE & FREQUENCY OF ANNUAL LOW FLOWS

Period (consecutive days)	Discharge, in cfs, for indicated recurrence intervals, in years		
	2	5	10
1	10	8.0	7.0
7	11	8.0	7.0
30	13	9.0	8.0

Remarks.-- State Fish Hatchery upstream diverts part of flow for its operations but returns it to the creek immediately downstream. Only rare changes in storage have been noted.

ADJUSTED TO STANDARD PERIOD, WATER YEARS 1931-60

Average discharge.-- 45 cfs

Duration of daily flow	Discharge, in cfs, which was equaled or exceeded for indicated percent of time								
	50	60	70	80	85	90	95	98	99
	31	26	22	18	16	14	12	10	8.9

2307. Bigelow Creek near South Byron, N.Y.

LOCATION.-- Lat 43°02'56", long 78°05'43", at bridge on County Highway 19, 1.5 miles west of South Byron, Genesee County, and 2.6 miles upstream from mouth.
RECORDS AVAILABLE.-- 1964-65.
DRAINAGE AREA.--

MAGNITUDE & FREQUENCY OF ANNUAL LOW FLOWS

Period (consecutive days)	Discharge, in cfs, for indicated recurrence intervals, in years		
	2	5	10
1	0.8	0.8	0.7
7	.8	.8	.8
30	.9	.8	.8

Remarks.-- Operated as a miscellaneous measuring site. Some diversions for irrigation have been noted upstream.

ADJUSTED TO STANDARD PERIOD, WATER YEARS 1931-60

Average discharge.--3.5 cfs

Duration of daily flow	Discharge, in cfs, which was equaled or exceeded for indicated percent of time								
	50	60	70	80	85	90	95	98	99
	2.1	1.7	1.4	1.1	1.0	1.0	0.9	0.8	0.8

2308. Spring Creek at Pumpkin Hill, N.Y.

LOCATION.--Lat 43°05'37", long 78°04'00", at bridge on State Highway 237, 0.2 mile south of Pumpkin Hill, Genesee County, and 1.2 miles upstream from mouth.
RECORDS AVAILABLE.-- 1964-65.
DRAINAGE AREA.--

MAGNITUDE & FREQUENCY OF ANNUAL LOW FLOWS

Period (consecutive days)	Discharge, in cfs, for indicated recurrence intervals, in years		
	2	5	10
1	1.9	1.7	1.6
7	1.9	1.8	1.7
30	2.4	2.0	1.9

Remarks.-- No known regulation or diversion.

ADJUSTED TO STANDARD PERIOD, WATER YEARS 1931-60

Average discharge.-- 17 cfs

Duration of daily flow	Discharge, in cfs, which was equaled or exceeded for indicated percent of time								
	50	60	70	80	85	90	95	98	99
	8.0	6.0	4.4	3.4	2.9	2.5	2.1	1.9	1.8

2310.5. Hotel Creek near Churchville, N.Y.

LOCATION.--Lat 43°05'08", long 77°51'44", at bridge on Robertson Road, 0.6 mile upstream from mouth, 1.7 miles southeast of Churchville, Monroe County.
RECORDS AVAILABLE.-- 1964-65.
DRAINAGE AREA.--

MAGNITUDE & FREQUENCY OF ANNUAL LOW FLOWS

Period (consecutive days)	Discharge, in cfs, for indicated recurrence intervals, in years		
	2	5	10
1	0.6	0.6	0.5
7	.7	.6	.5
30	1.0	.8	.6

Remarks.--No known regulation or diversion.

ADJUSTED TO STANDARD PERIOD, WATER YEARS 1931-60

Average discharge.-- 4.5 cfs

Duration of daily flow	Discharge, in cfs, which was equaled or exceeded for indicated percent of time								
	50	60	70	80	85	90	95	98	99
	2.7	2.1	1.7	1.4	1.2	1.0	0.8	0.7	0.6

2311. Mill Creek near West Chili, N.Y.

LOCATION.-- Lat 43°04'31", long 77°46'56", at bridge on Stottle Road, 1.5 miles southeast of West Chili, Monroe County, and 1.5 miles southeast of West Chili, Monroe County, and 1.5 miles upstream from mouth.
RECORDS AVAILABLE.-- 1964-65.
DRAINAGE AREA.--

MAGNITUDE & FREQUENCY OF ANNUAL LOW FLOWS

Period (consecutive days)	Discharge, in cfs, for indicated recurrence intervals, in years		
	2	5	10
1	2.5	2.3	2.2
7	2.5	2.3	2.2
30	3.1	2.6	2.4

Remarks.-- No known regulation or diversion.

ADJUSTED TO STANDARD PERIOD, WATER YEARS 1931-60

Average discharge.-- 11 cfs

Duration of daily flow	Discharge, in cfs, which was equaled or exceeded for indicated percent of time								
	50	60	70	80	85	90	95	98	99
	7.0	5.8	4.8	4.0	3.6	3.2	2.8	2.5	2.4

2314. Red Creek near Rochester, N.Y.

LOCATION.-- Lat 43°05'32", long 77°39'08", at State Highway 252 near Rochester, Monroe County, and 2.2 miles upstream from Erie Canal.
RECORDS AVAILABLE.-- 1964-65.
DRAINAGE AREA.--

MAGNITUDE & FREQUENCY OF ANNUAL LOW FLOWS

Period (consecutive days)	Discharge, in cfs, for indicated recurrence intervals, in years		
	2	5	10
1	0.01	0.01	0.01
7	.02	.01	.01
30	.05	.02	.01

Remarks.-- No known regulation or diversion. Industrial and domestic wastes from upstream areas may influence low flows to some extent.

ADJUSTED TO STANDARD PERIOD, WATER YEARS 1931-60

Average discharge.-- 4.5 cfs

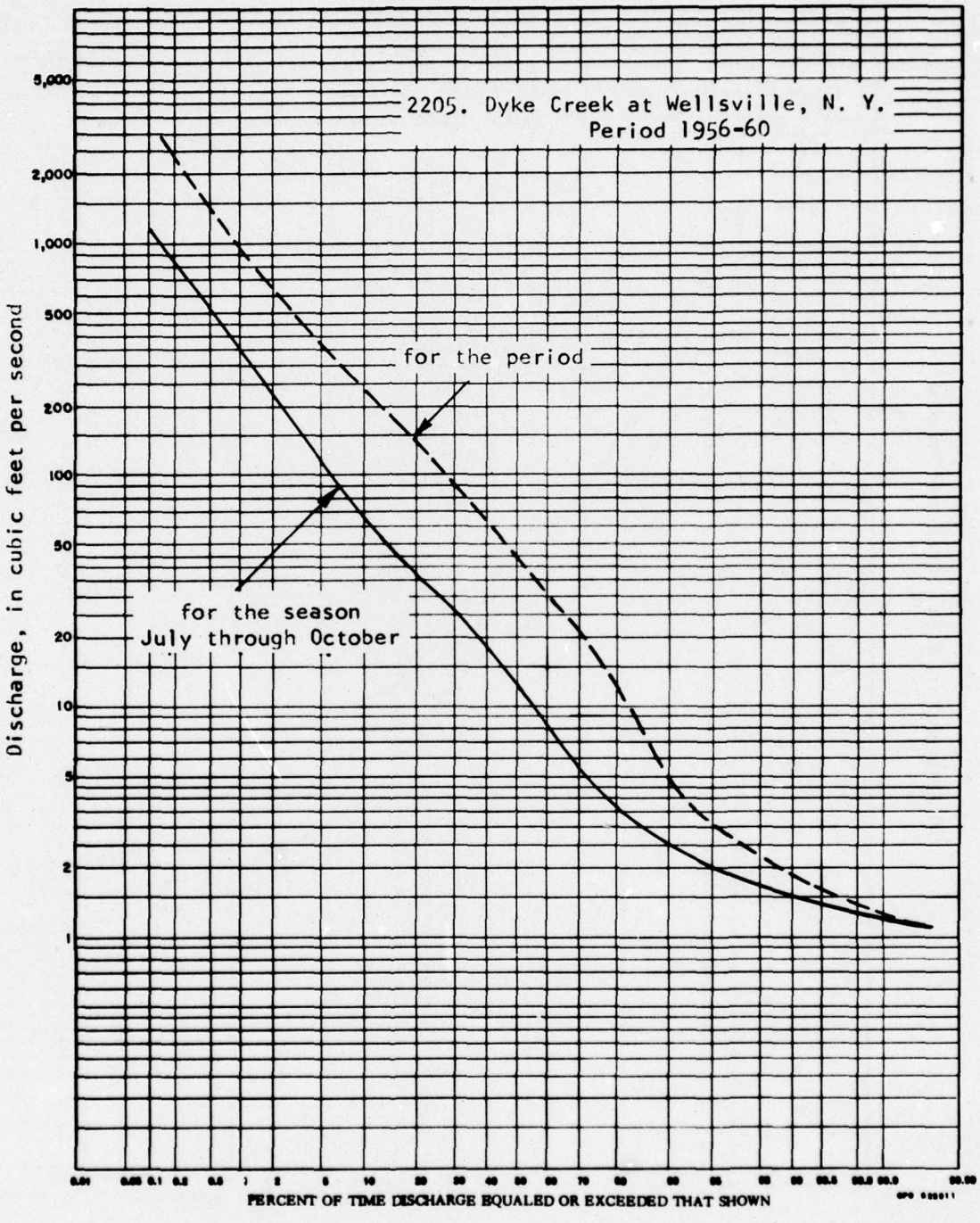
Duration of daily flow	Discharge, in cfs, which was equaled or exceeded for indicated percent of time								
	50	60	70	80	85	90	95	98	99
	1.3	0.7	0.4	0.2	0.1	0.06	0.03	0.01	0.01

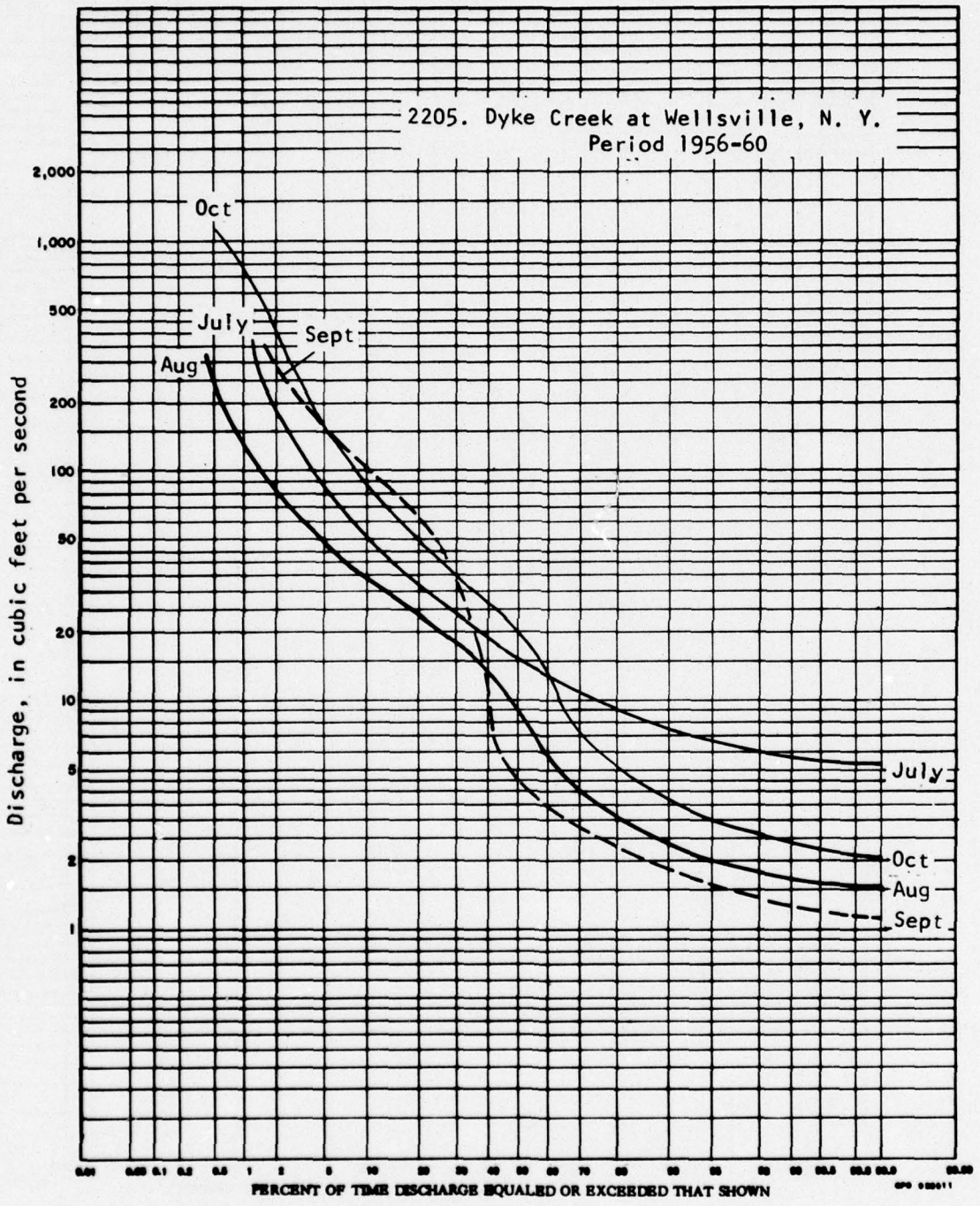
APPENDIX SECTION 1d

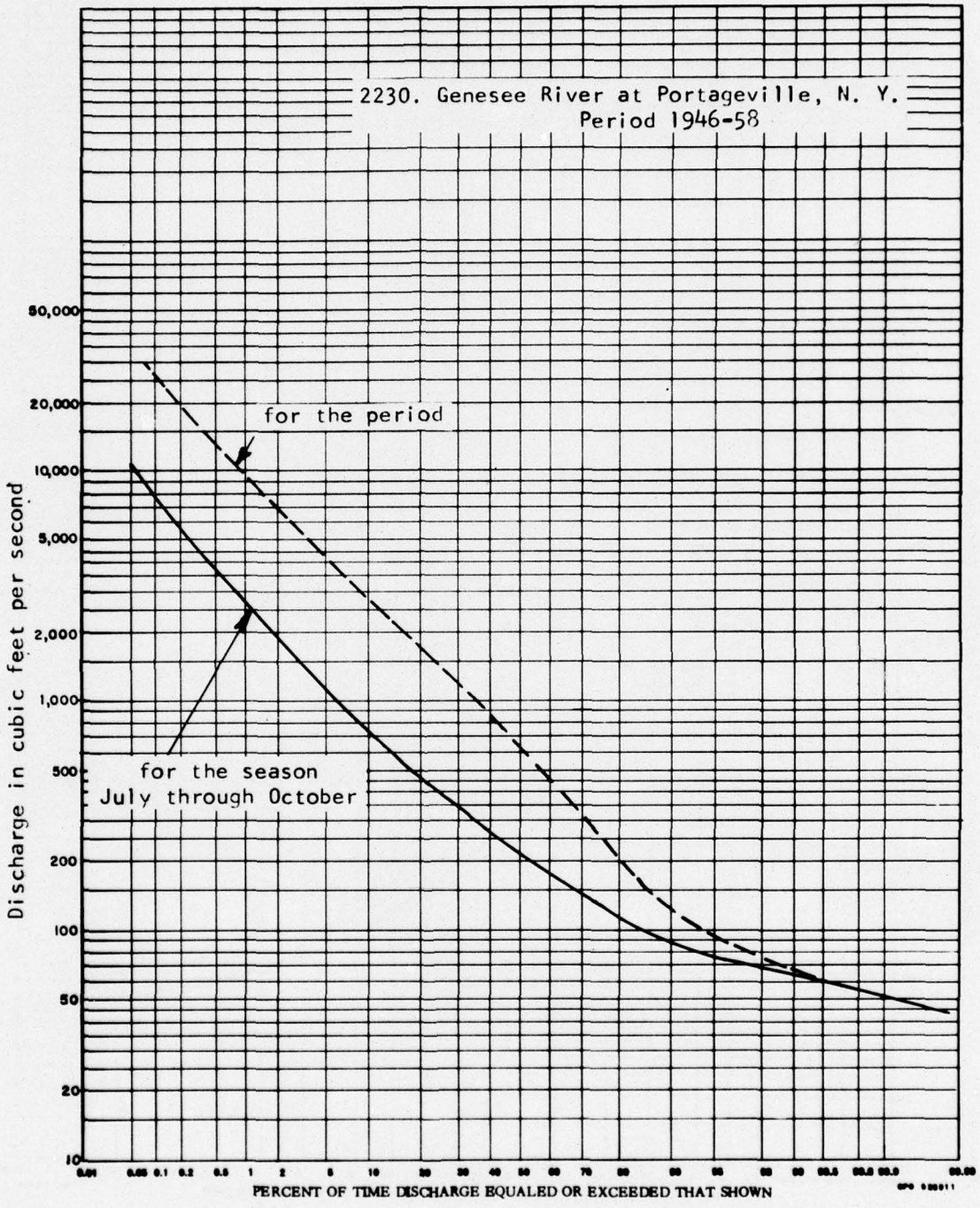
Approximate duration of daily flows (adjusted to standard period 1931-60) for selected miscellaneous measuring sites in the Genesee River basin.

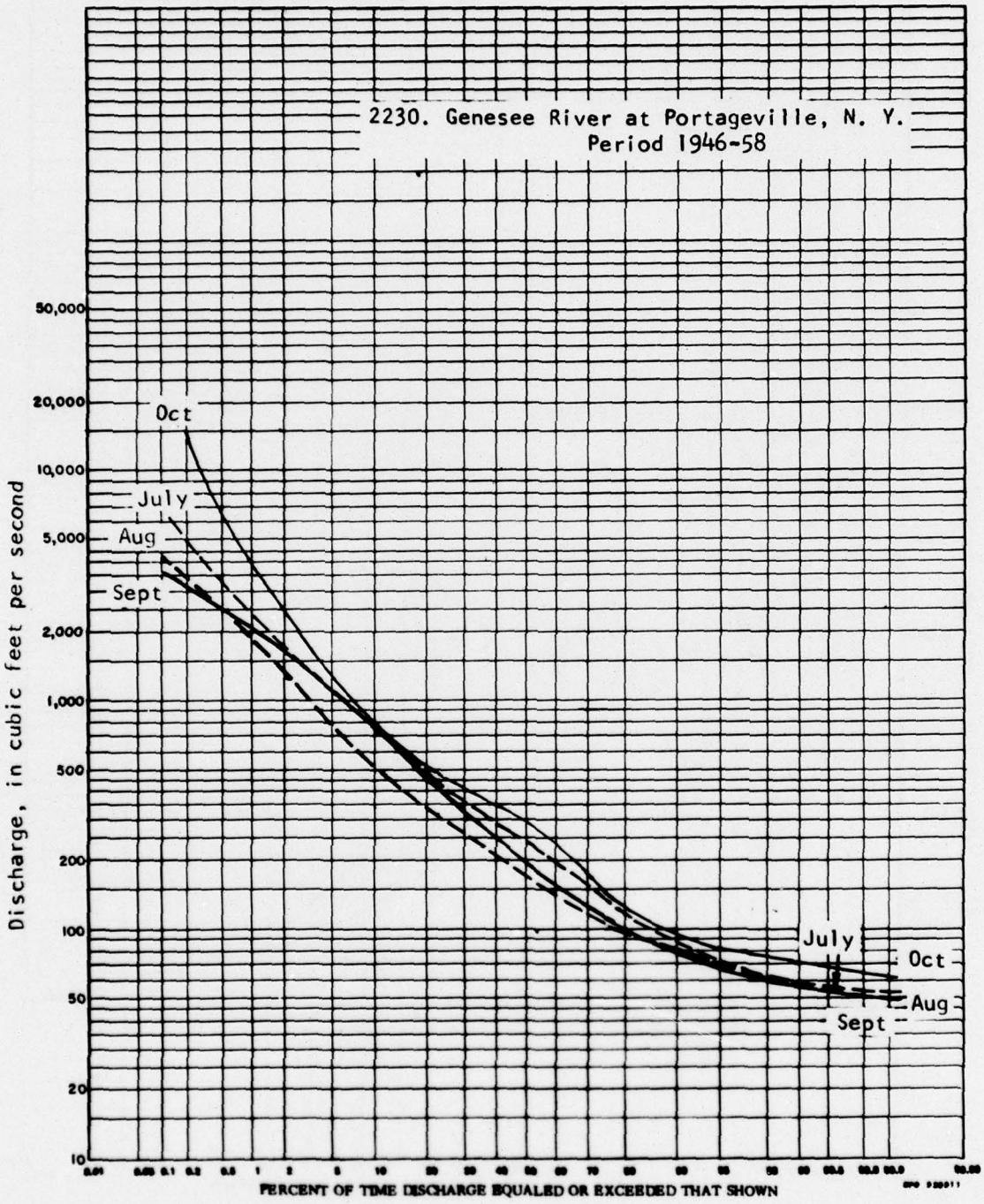
Site		Location	Discharge, in cfs, which was equaled or exceeded for indicated percent of time					
			80	85	90	95	98	99
2203.	Genesee River at Hickox, Pa.	Lat 41°58'33", long 77°51'26", at bridge at Hickox, Potter County, Pa., 200 ft upstream from Middle Branch Genesee River.	6.3	4.5	3.3	2.2	1.6	1.4
2203.1.	Mid. Br. Genesee River at Hickox, Pa.	Lat 41°58'30", long 77°51'28", at bridge at Hickox, Potter County, Pa. 300 ft upstream from mouth.	5.6	4.6	3.6	2.7	2.0	1.7
2203.4.	West Br. Genesee River at Genesee, Pa.	Lat 41°59'30", long 77°52'14", at bridge on State Highway 449 at Genesee, Potter County, Pa., 0.1 mile upstream from mouth.	4.0	3.2	2.5	1.9	1.7	1.6
2203.5.	Genesee River at Genesee, Pa.	Lat 41°59'40", long 77°52'14", at highway bridge in Genesee, Potter County, Pa., 0.2 mile upstream from Cryder Creek, and 0.2 mile downstream from West Branch Genesee River.	17	13	10	7.4	6.0	5.4
2248.5.	Stony Brook near Stony Brook Glen, N.Y.	Lat 42°31'38", long 77°41'45", at bridge on State Highway 36, 1.1 miles north of Stony Brook Glen, Steuben County, and 1.2 miles upstream from mouth.	3.6	3.3	3.1	2.8	2.4	2.3
2249.8.	Mill Creek at Dansville, N.Y.	Lat 42°33'15", long 77°42'04", at bridge on State Highway 36, at Dansville, Livingston County, and 0.5 mile upstream from mouth.	14	13	12	10	8.5	8.0
2304.3.	Oatka Creek near Roanoke, N.Y.	Lat 42°57'25", long 78°01'31", 0.1 mile upstream from bridge on Cole Road, 0.1 mile downstream from unnamed tributary, and 1.6 miles northeast of Roanoke, Genesee County.	7.0	6.0	4.9	3.8	3.1	2.8
2304.8.	Oatka Creek near Lime Rock, N.Y.	Lat 43°00'05", long 77°55'17", at a point along Oatka Trail Road, 0.8 mile upstream from Genesee-Monroe County line, and 1.6 miles north of Lime Rock, Genesee County.	5.5	5.1	4.5	3.8	3.1	2.8

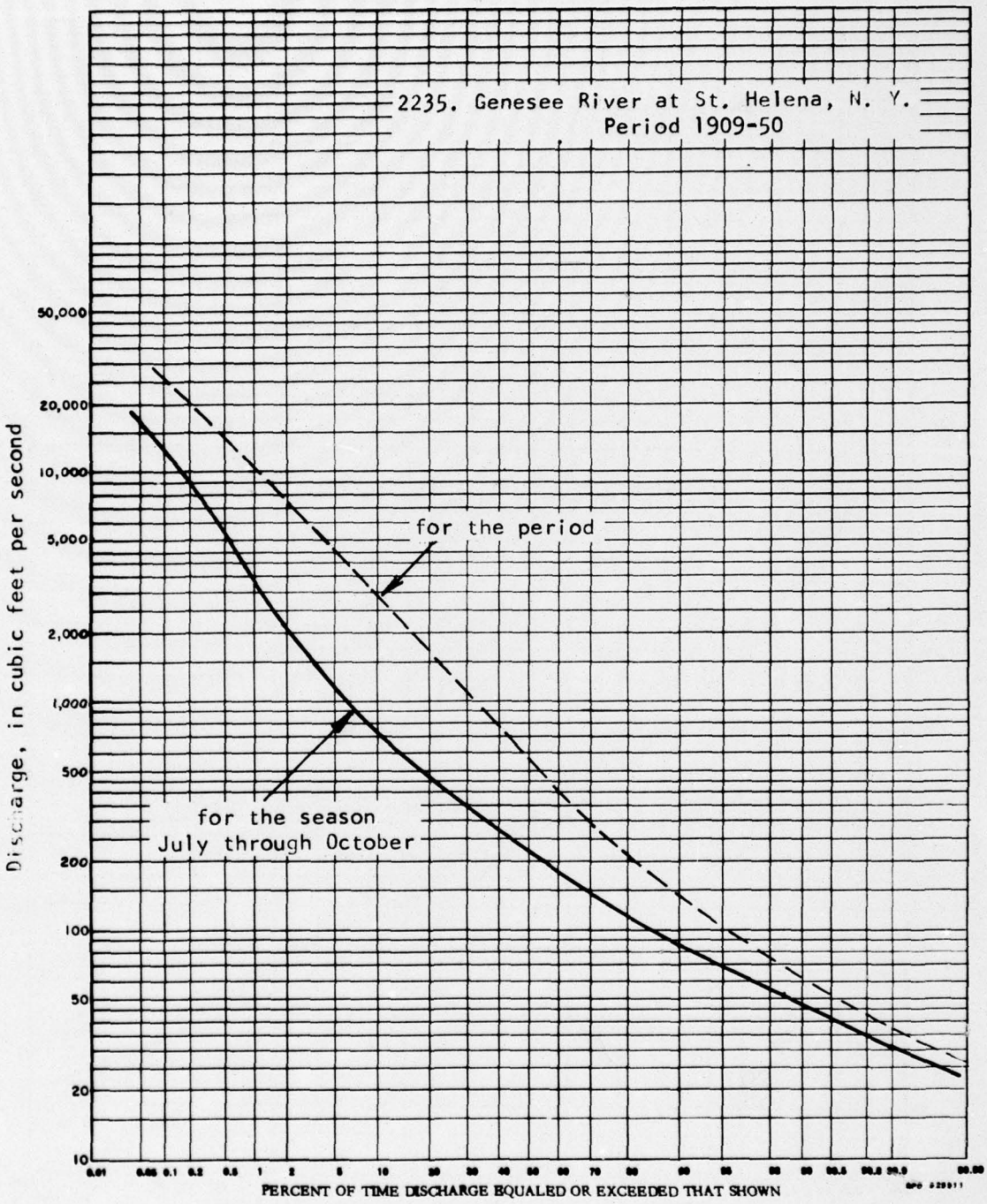
Duration curves of daily flow by season and by months (July through October) for selected gaging stations in the Genesee River basin.

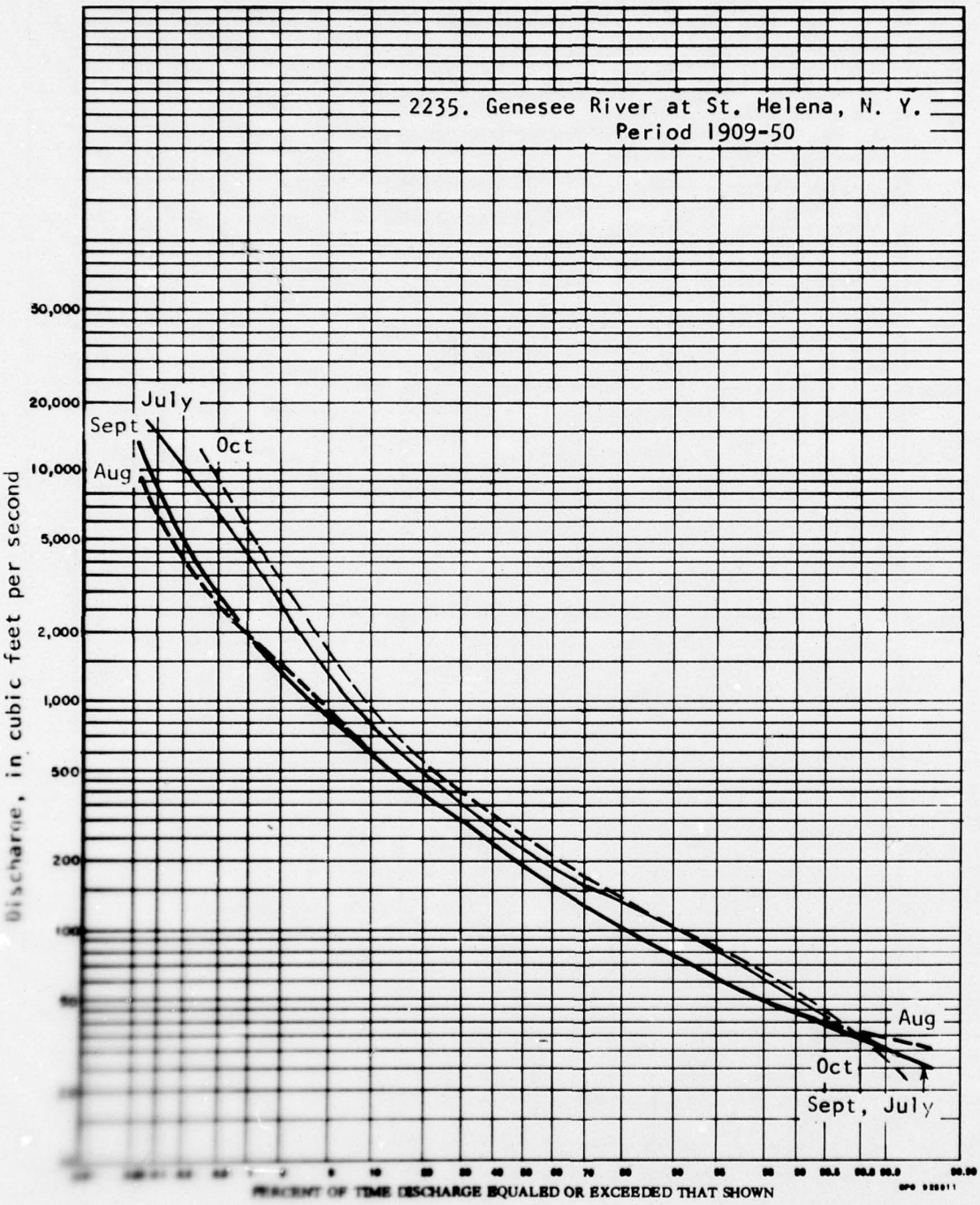


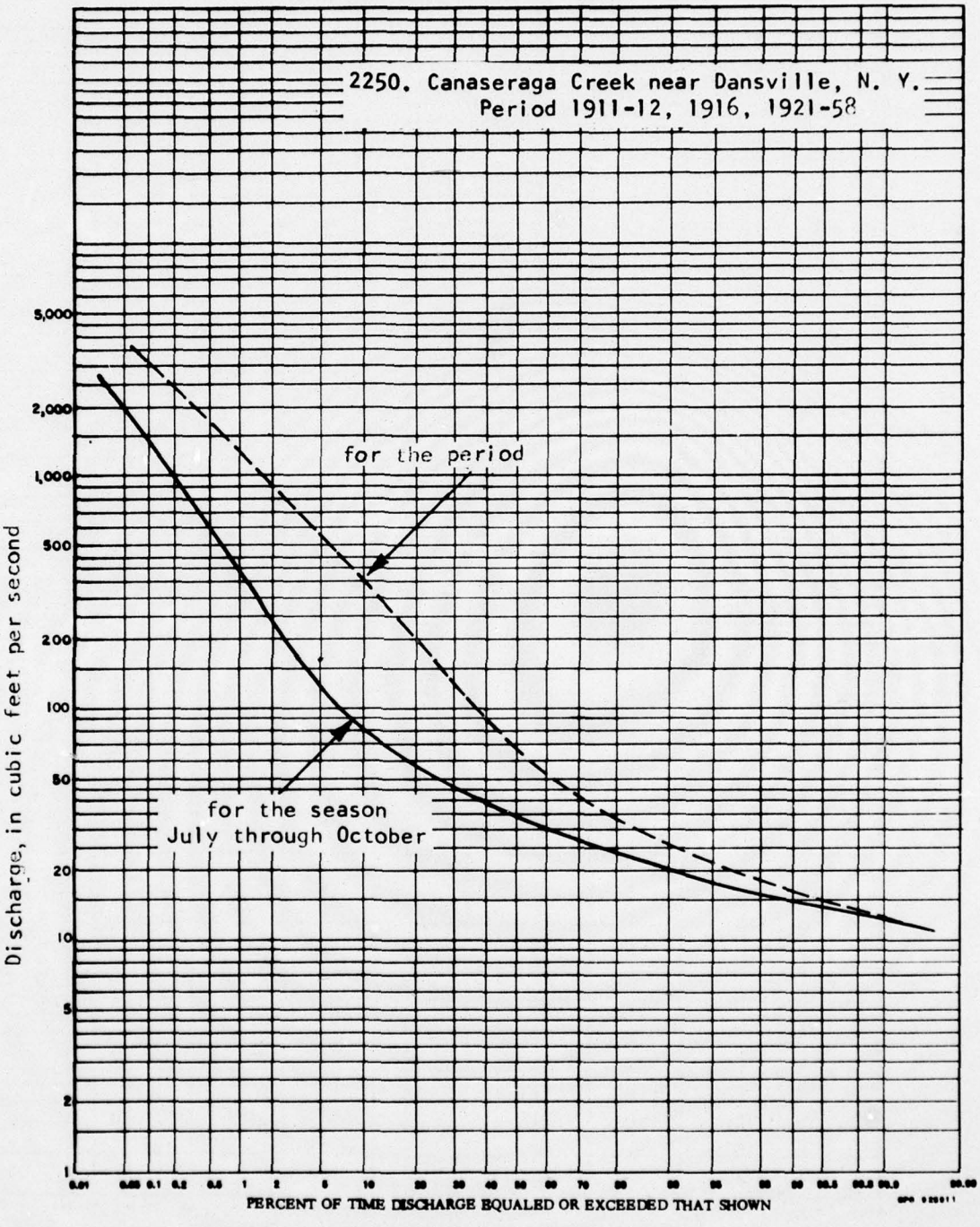

2205. Dyke Creek at Wellsville, N. Y.
Period 1956-60
Discharge, in cubic feet per second
2,000
1,000
500
200
100
50
20
10
5
2
1
Oct
July
Sept
Aug
July
Oct
Aug
Sept
PERCENT OF TIME DISCHARGE EQUALED OR EXCEEDED THAT SHOWN

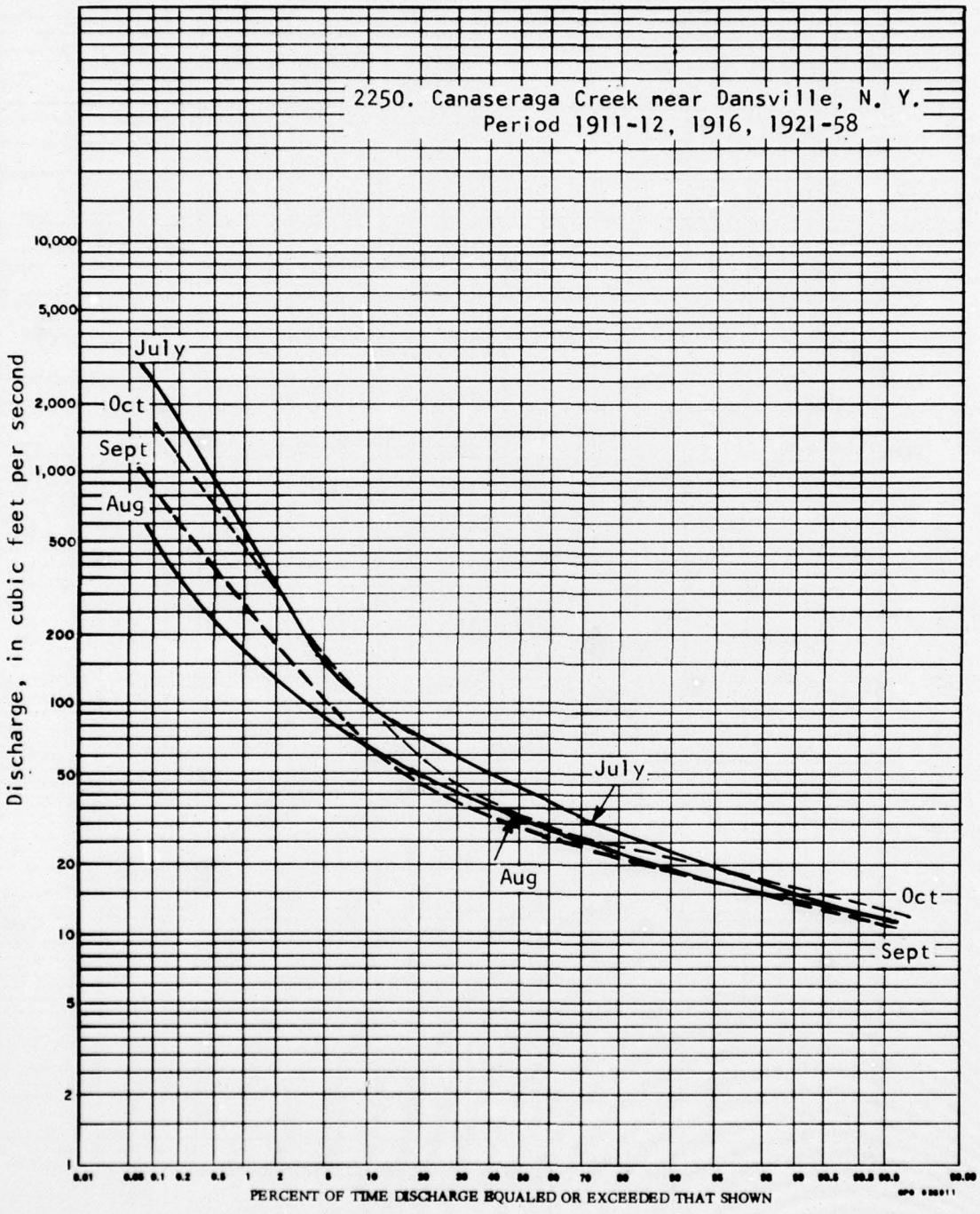

2230. Genesee River at Portageville, N. Y.
Period 1946-58
for the period
for the season
July through October
Discharge in cubic feet per second
50,000
20,000
10,000
5,000
2,000
1,000
500
200
100
50
20
10
PERCENT OF TIME DISCHARGE EQUALED OR EXCEEDED THAT SHOWN

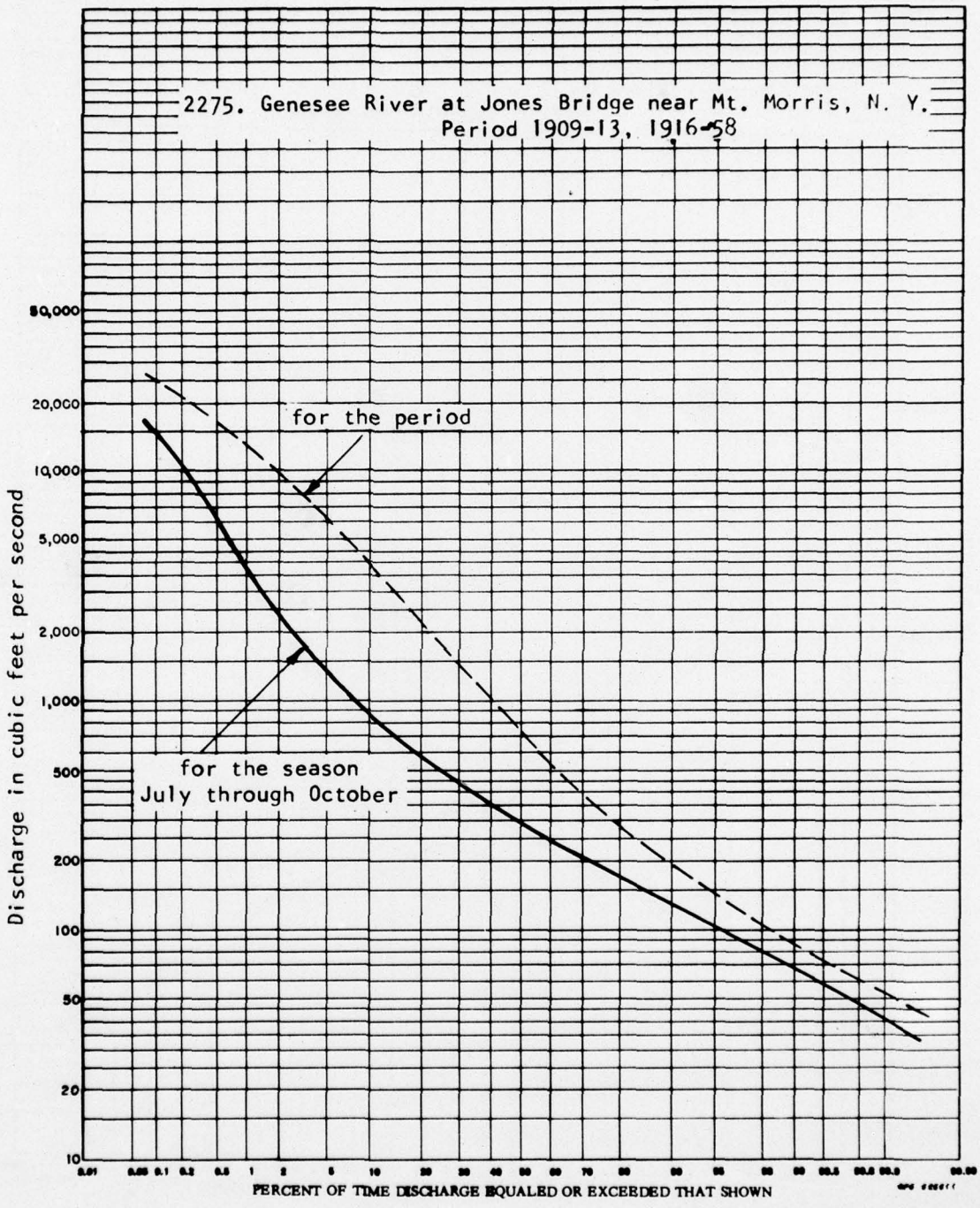

2230. Genesee River at Portageville, N. Y.
Period 1946-58
Discharge, in cubic feet per second
50,000
20,000
10,000
5,000
2,000
1,000
500
200
100
50
20
10
Oct
July
Aug
Sept
July
Oct
Aug
Sept
PERCENT OF TIME DISCHARGE EQUALED OR EXCEEDED THAT SHOWN

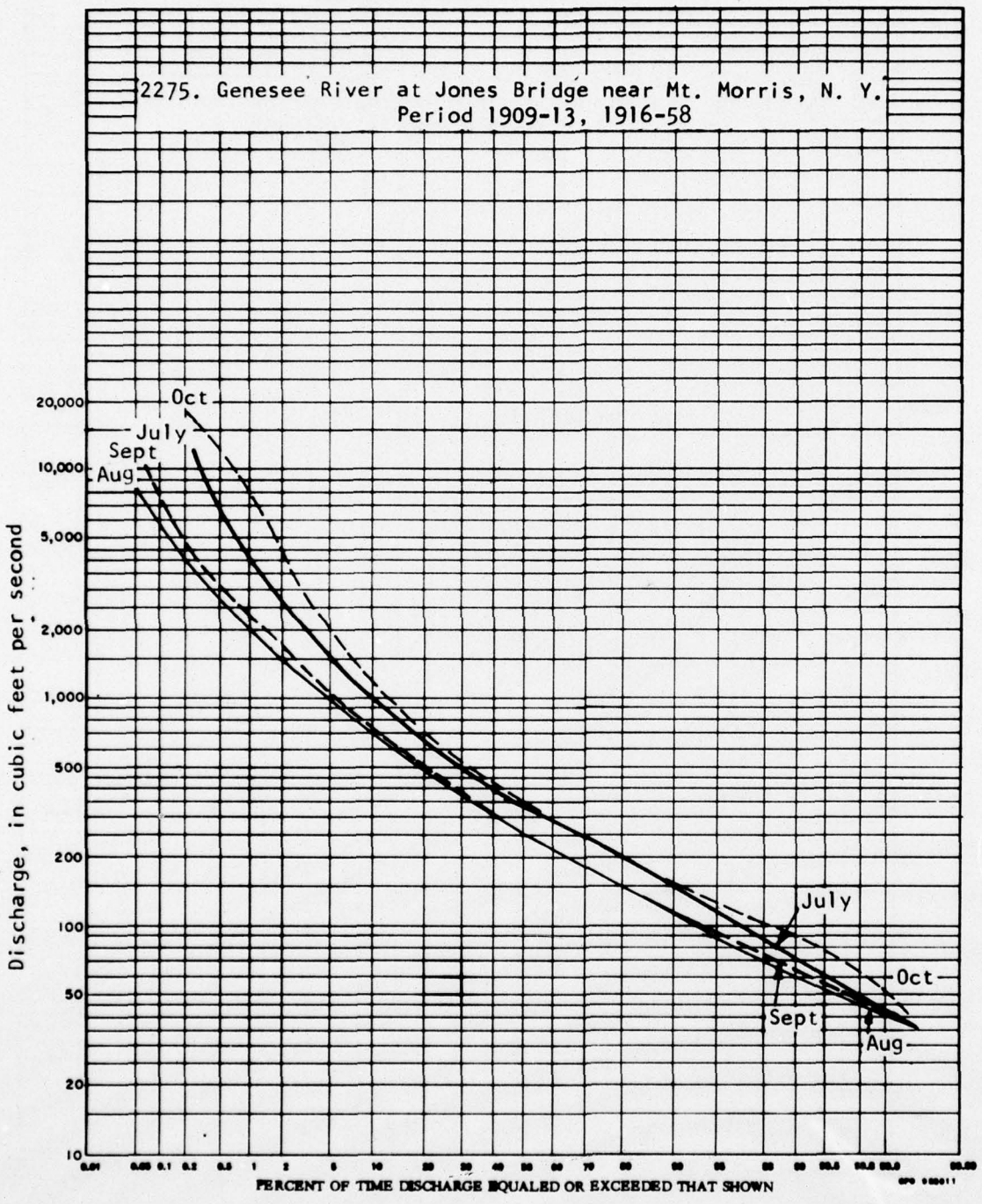

2235. Genesee River at St. Helena, N. Y.
Period 1909-50
for the period
for the season
July through October
Discharge, in cubic feet per second
50,000
20,000
10,000
5,000
2,000
1,000
500
200
100
50
20
10
PERCENT OF TIME DISCHARGE EQUALED OR EXCEEDED THAT SHOWN

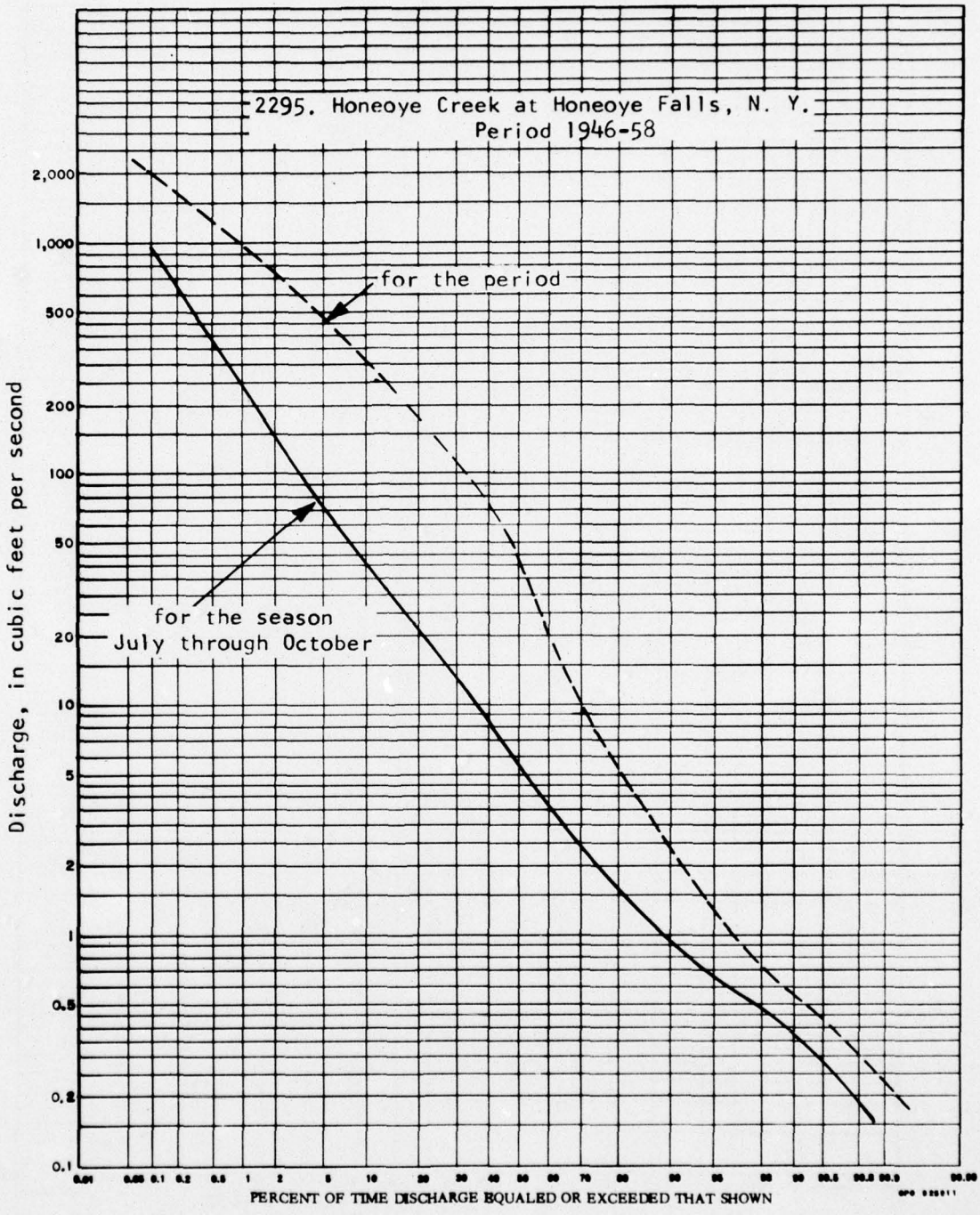

2235. Genesee River at St. Helena, N. Y.
Period 1909-50
Discharge, in cubic feet per second
50,000
20,000
10,000
5,000
2,000
1,000
500
200
July
Sept
Aug
Oct
Aug
Oct
Sept, July
PERCENT OF TIME DISCHARGE EQUALED OR EXCEEDED THAT SHOWN

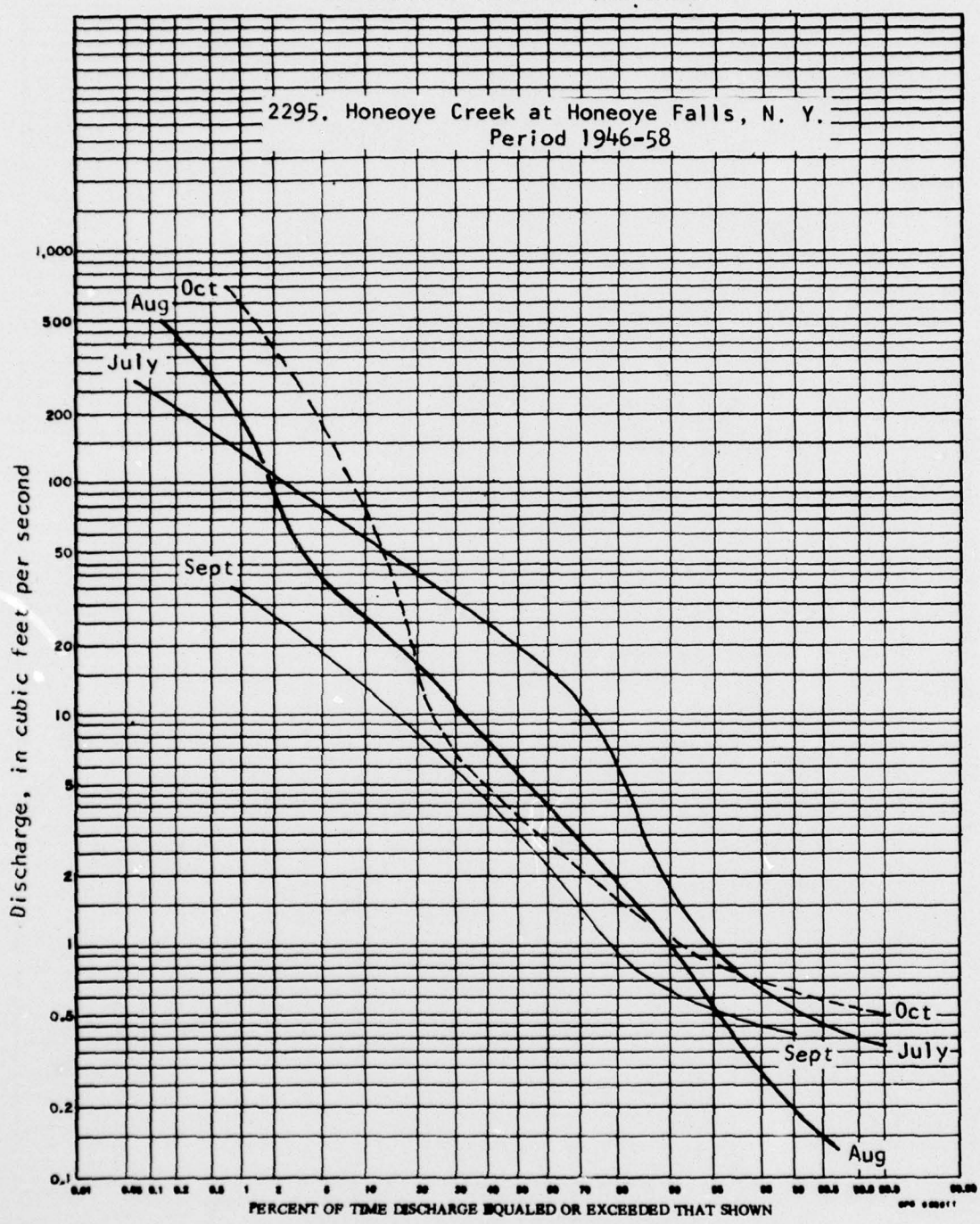

2250. Canaseraga Creek near Dansville, N. Y.
Period 1911-12, 1916, 1921-58
for the period
for the season
July through October
Discharge, in cubic feet per second
5,000
2,000
1,000
500
200
100
50
20
10
5
2
1
PERCENT OF TIME DISCHARGE EQUALED OR EXCEEDED THAT SHOWN

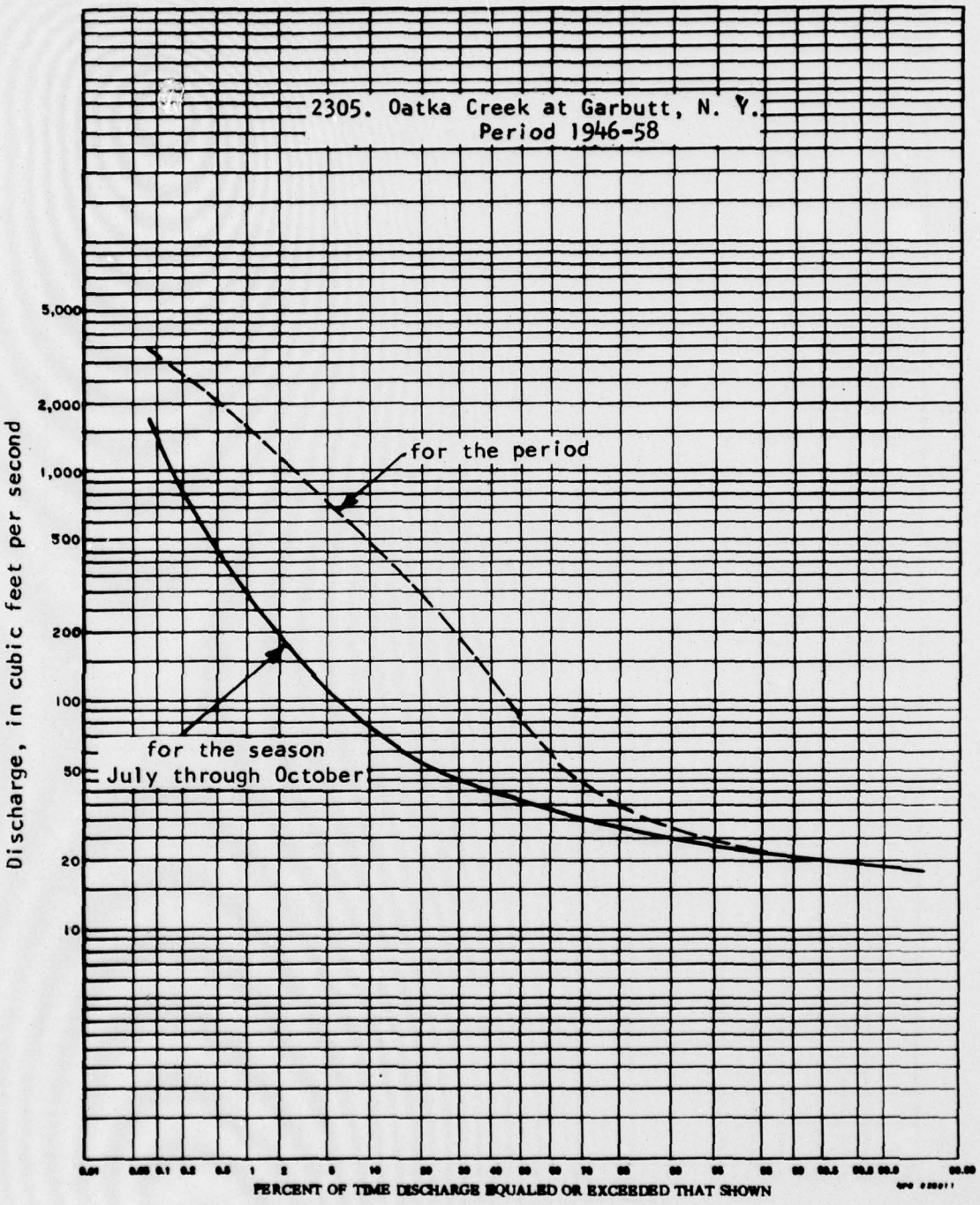

2250. Canaseraga Creek near Dansville, N. Y.
Period 1911-12, 1916, 1921-58
Discharge, in cubic feet per second
10,000
5,000
2,000
1,000
500
200
100
50
20
10
5
2
1
July
Oct
Sept
Aug
July
Aug
Oct
Sept
PERCENT OF TIME DISCHARGE EQUALED OR EXCEEDED THAT SHOWN

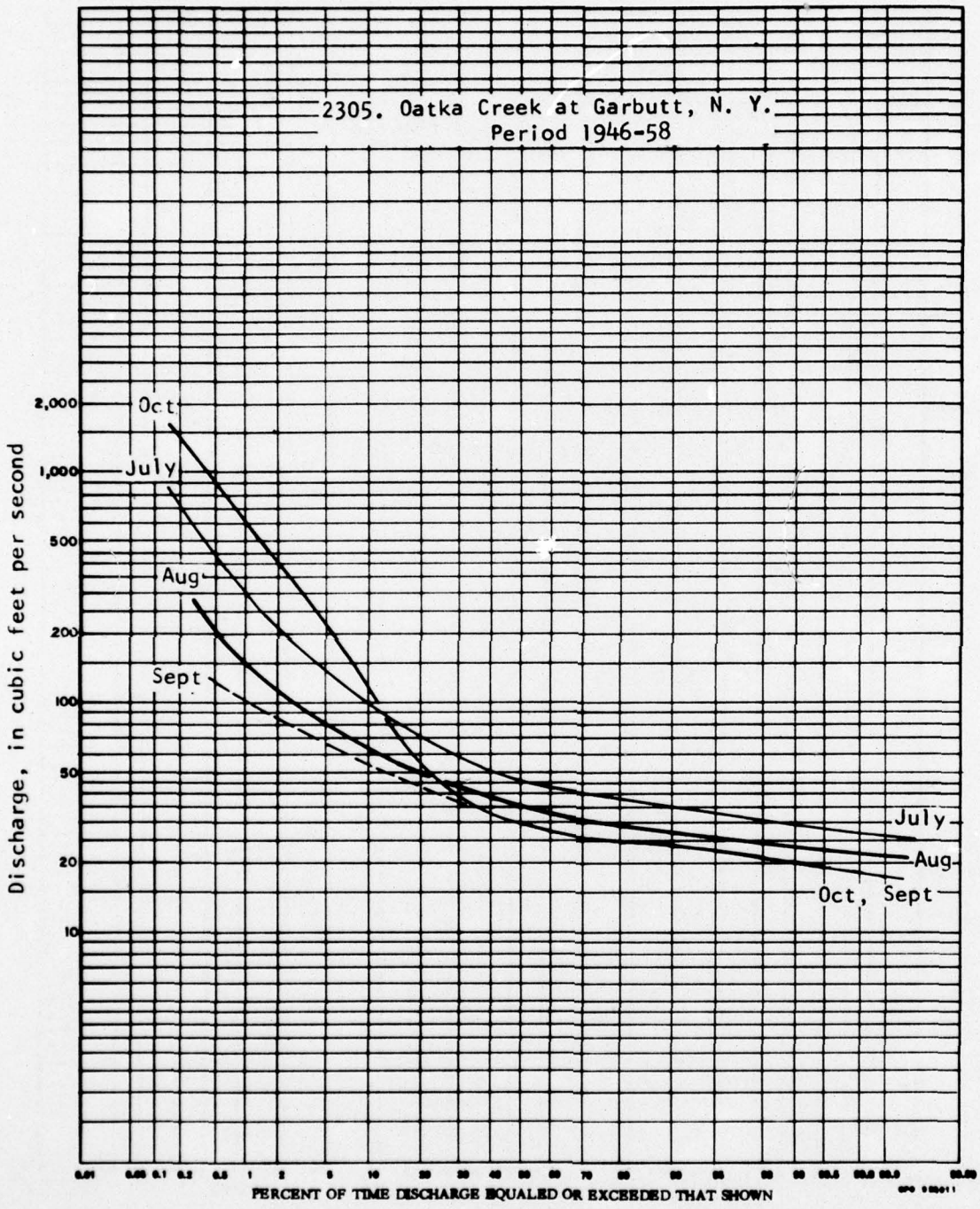

2275. Genesee River at Jones Bridge near Mt. Morris, N. Y.
Period 1909-13, 1916-58
for the period
for the season
July through October
Discharge in cubic feet per second
50,000
20,000
10,000
5,000
2,000
1,000
500
200
100
50
20
10
PERCENT OF TIME DISCHARGE EQUALED OR EXCEEDED THAT SHOWN

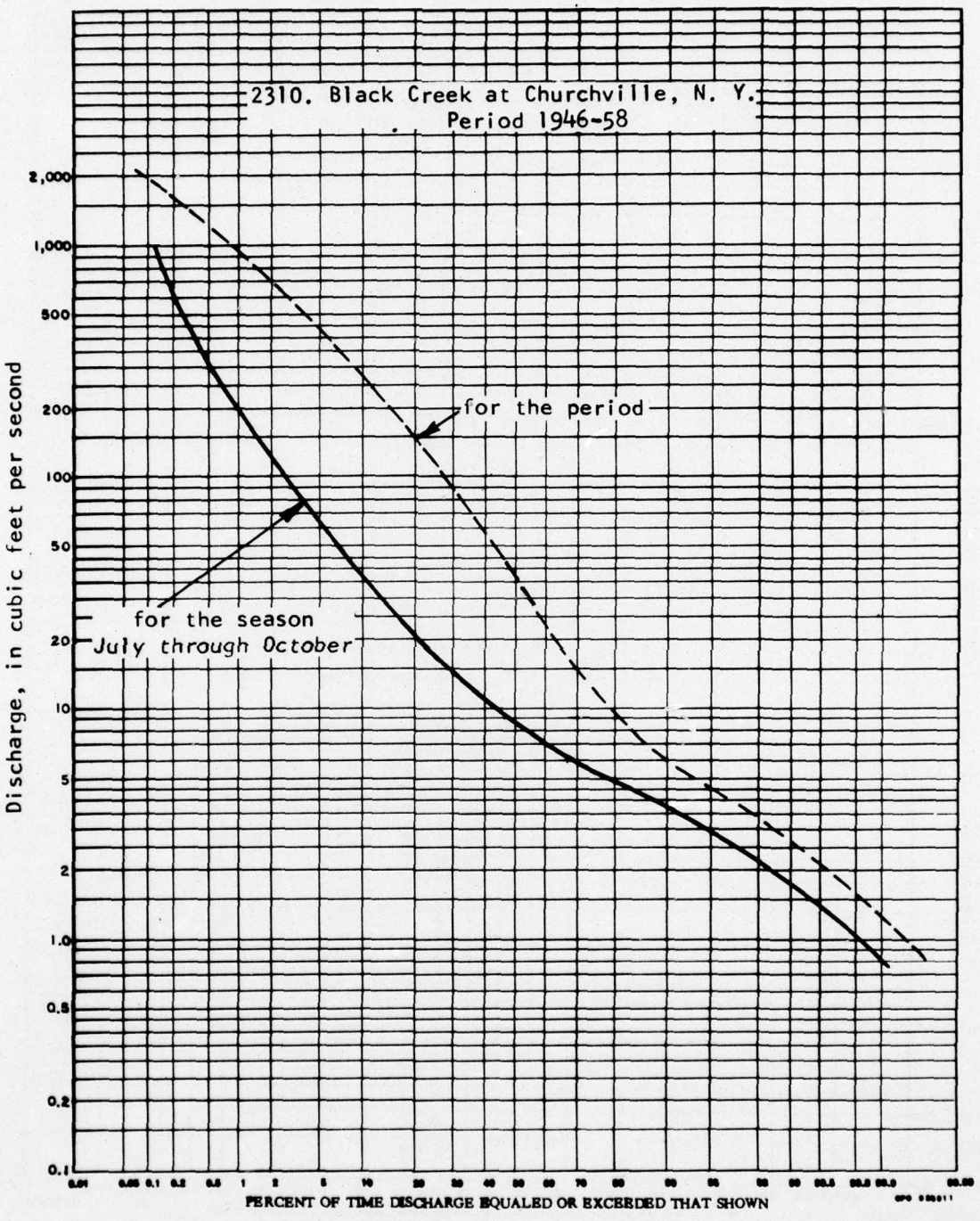

2275. Genesee River at Jones Bridge near Mt. Morris, N. Y.
Period 1909-13, 1916-58
Oct
July
Sept
Aug
20,000
10,000
5,000
2,000
1,000
500
200
100
50
20
10
Discharge, in cubic feet per second
July
Oct
Sept
Aug
PERCENT OF TIME DISCHARGE EQUALED OR EXCEEDED THAT SHOWN

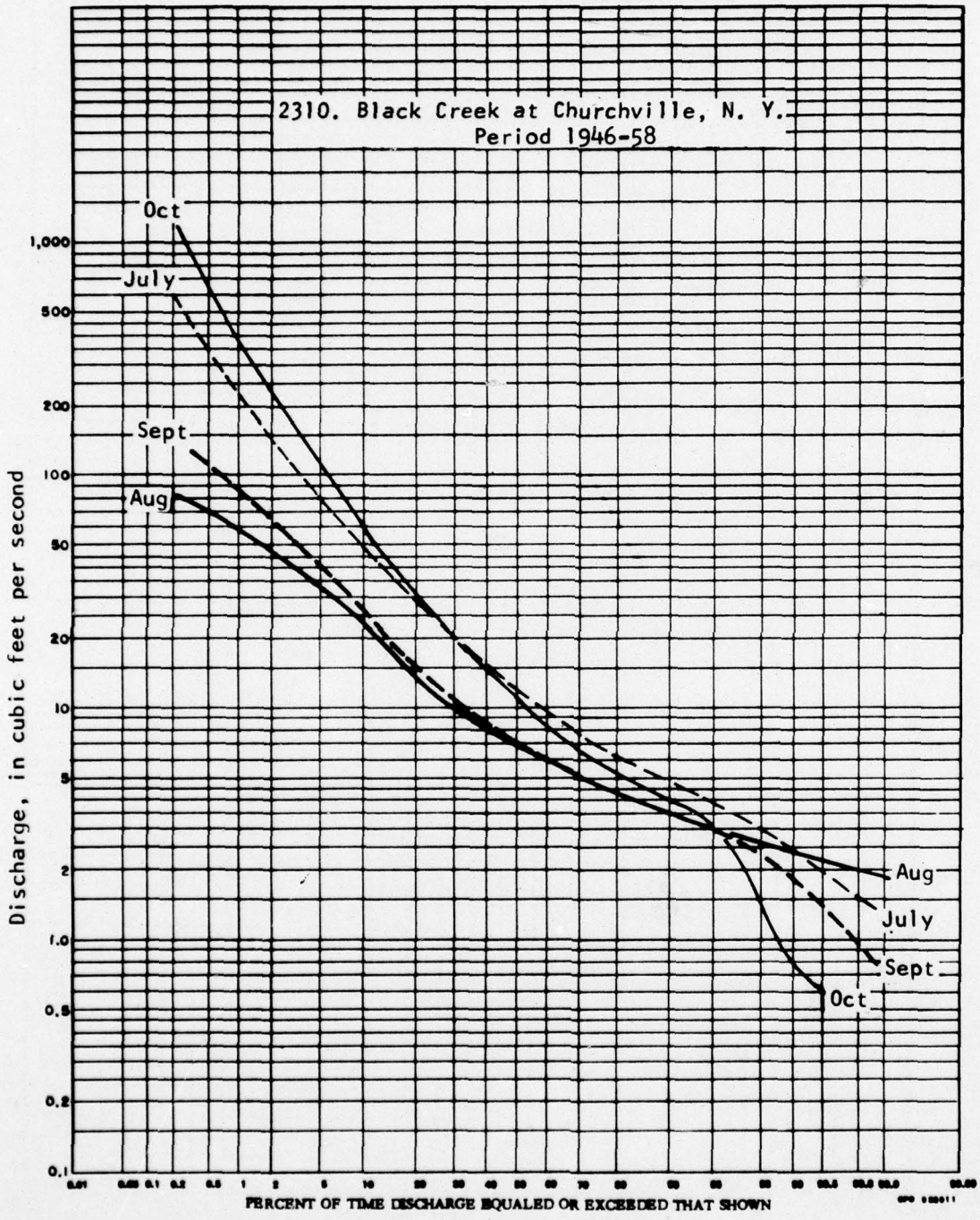

2295. Honeoye Creek at Honeoye Falls, N. Y.
Period 1946-58
for the period
for the season
July through October
Discharge, in cubic feet per second
2,000
1,000
500
200
100
50
20
10
5
2
1
0.5
0.2
0.1
PERCENT OF TIME DISCHARGE EQUALED OR EXCEEDED THAT SHOWN


2295. Honeoye Creek at Honeoye Falls, N. Y.
Period 1946-58
Discharge, in cubic feet per second
1,000
500
200
100
50
20
10
5
2
1
0.5
0.2
0.1
Aug
Oct
July
Sept
Oct
Sept
July
Aug
PERCENT OF TIME DISCHARGE EQUALED OR EXCEEDED THAT SHOWN


2305. Oatka Creek at Garbutt, N. Y.
Period 1946-58
for the period
for the season
July through October
Discharge, in cubic feet per second
5,000
2,000
1,000
500
200
100
50
20
10
PERCENT OF TIME DISCHARGE EQUALED OR EXCEEDED THAT SHOWN

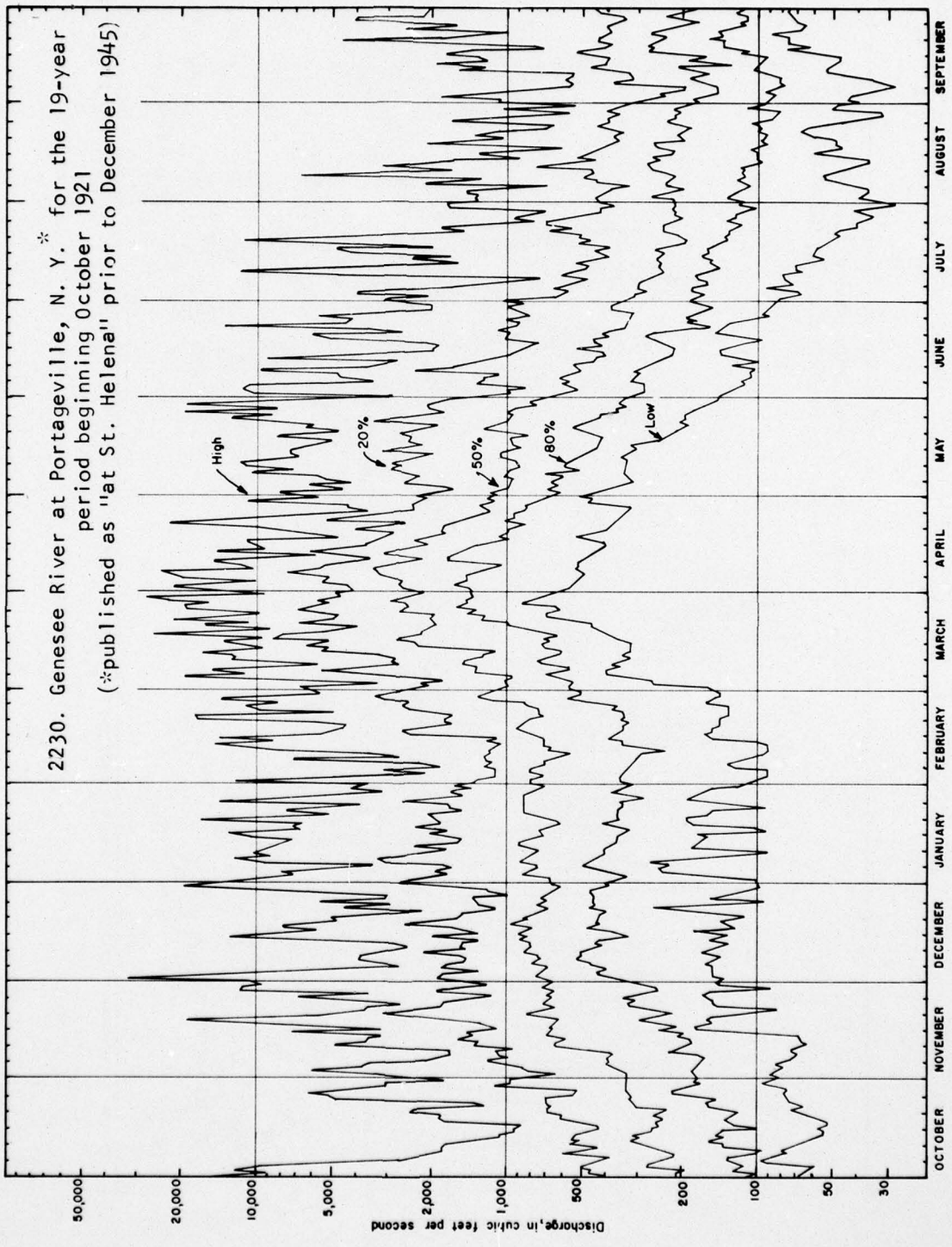

2305. Oatka Creek at Garbutt, N. Y.
Period 1946-58
Discharge, in cubic feet per second
2,000
1,000
500
200
100
50
20
10
Oct
July
Aug
Sept
July
Aug
Oct, Sept
PERCENT OF TIME DISCHARGE EQUALED OR EXCEEDED THAT SHOWN

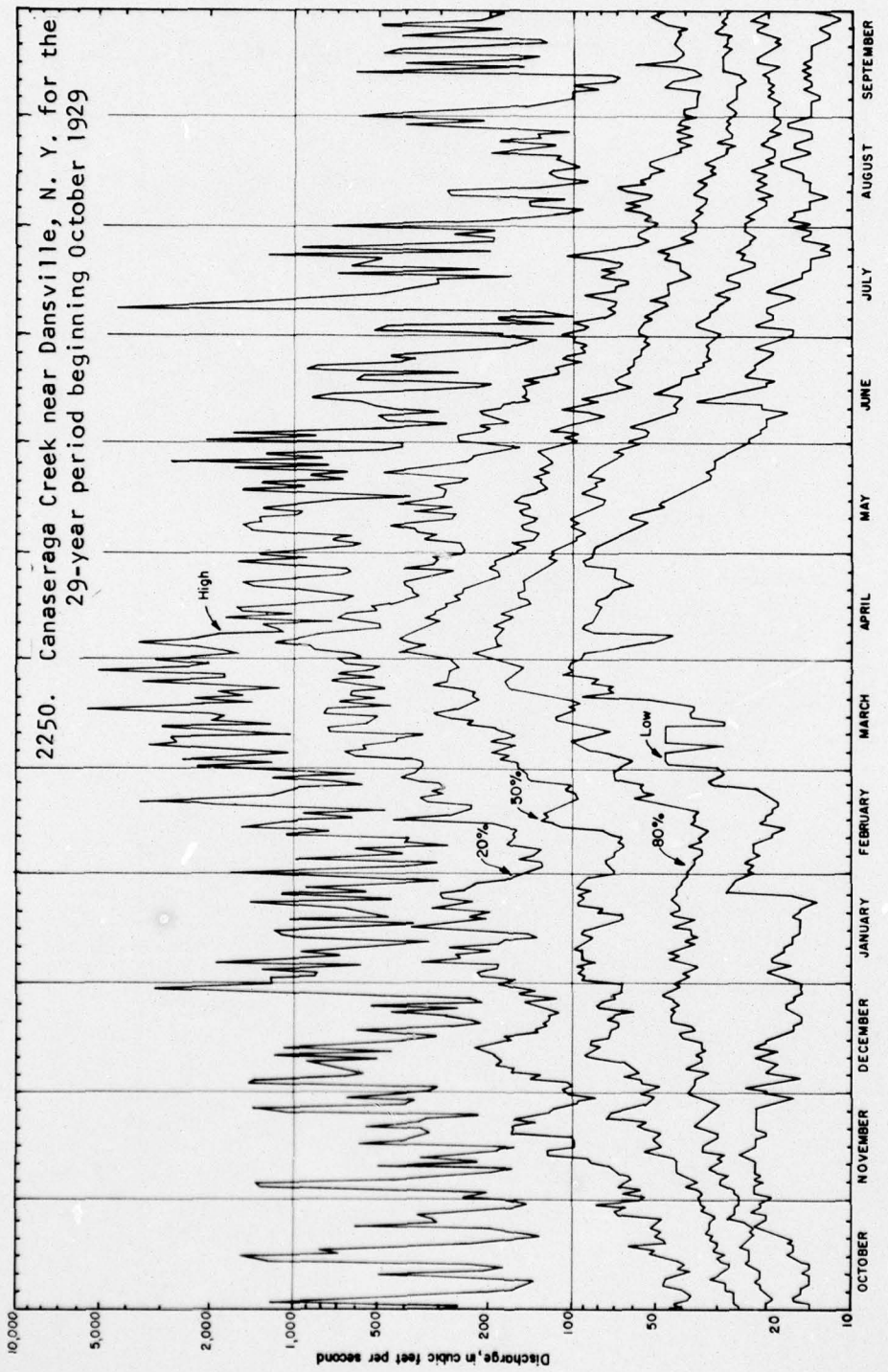

2310. Black Creek at Churchville, N. Y.
Period 1946-58
for the period
for the season
July through October
Discharge, in cubic feet per second
2,000
1,000
500
200
100
50
20
10
5
2
1.0
0.5
0.2
0.1
PERCENT OF TIME DISCHARGE EQUALED OR EXCEEDED THAT SHOWN

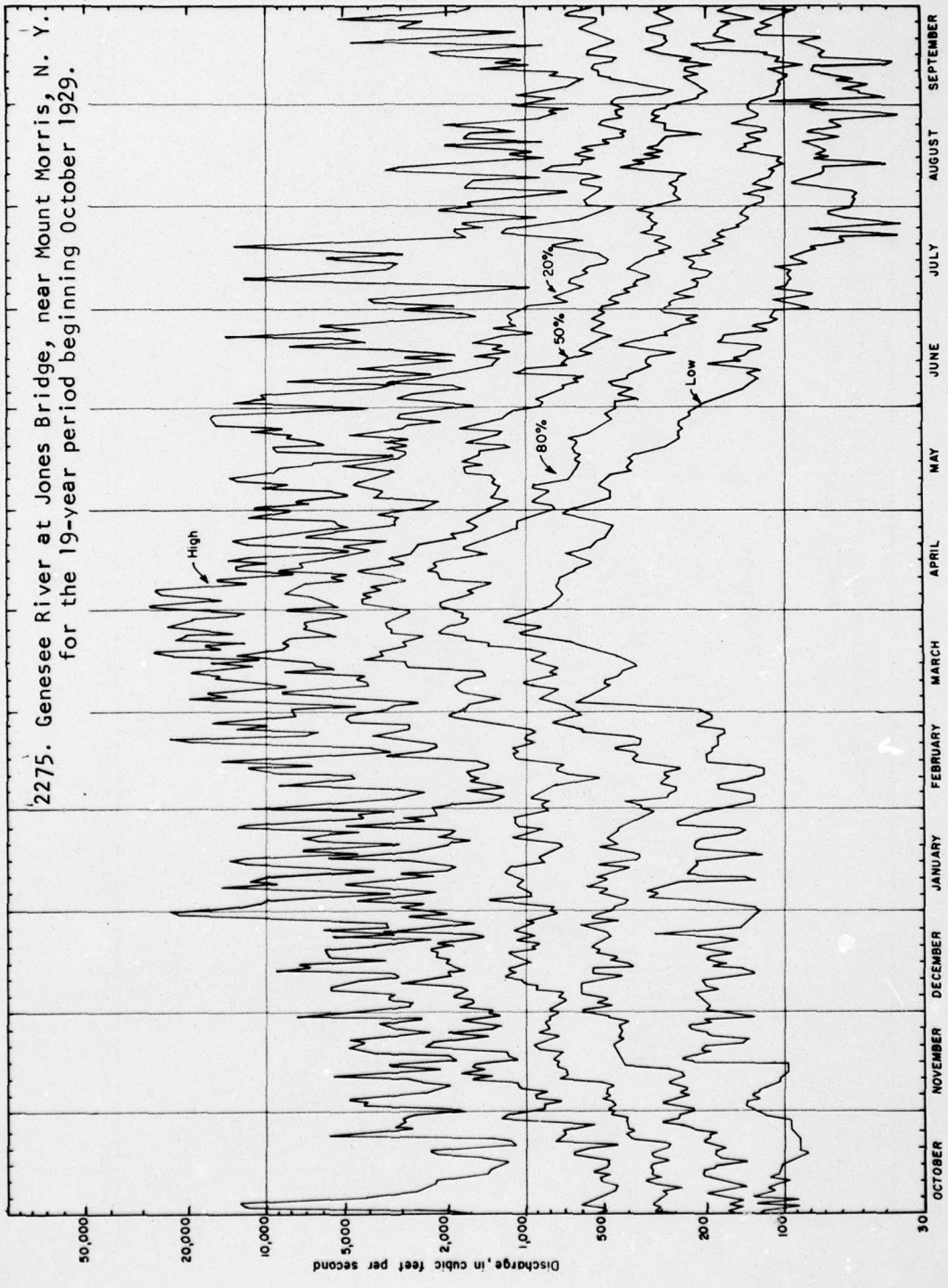

2310. Black Creek at Churchville, N. Y.
Period 1946-58
Oct
July
Sept
Aug
Aug
July
Sept
Oct
1,000
500
200
100
50
20
10
5
2
1.0
0.5
0.2
0.1
Discharge, in cubic feet per second
PERCENT OF TIME DISCHARGE EQUALED OR EXCEEDED THAT SHOWN

APPENDIX SECTION III

Duration hydrographs for selected gaging stations in the Genesee River basin




2250. Canaseraga Creek near Dansville, N. Y. for the 29-year period beginning October 1929
High
Low
20%
50%
80%
Discharge, in cubic feet per second
10,000
5,000
2,000
1,000
500
200
100
50
20
10
OCTOBER
NOVEMBER
DECEMBER
JANUARY
FEBRUARY
MARCH
APRIL
MAY
JUNE
JULY
AUGUST
SEPTEMBER


2275. Genesee River at Jones Bridge, near Mount Morris, N. Y.
for the 19-year period beginning October 1929.
High
20%
50%
80%
Low
Discharge, in cubic feet per second
50,000
20,000
10,000
5,000
2,000
1,000
500
200
100
30
OCTOBER
NOVEMBER
DECEMBER
JANUARY
FEBRUARY
MARCH
APRIL
MAY
JUNE
JULY
AUGUST
SEPTEMBER

AD-A041 706 CORPS OF ENGINEERS BUFFALO N Y BUFFALO DISTRICT F/G 8/6
GENESEE RIVER BASIN COMPREHENSIVE STUDY OF WATER AND RELATED LA--ETC(U)
JUN 66

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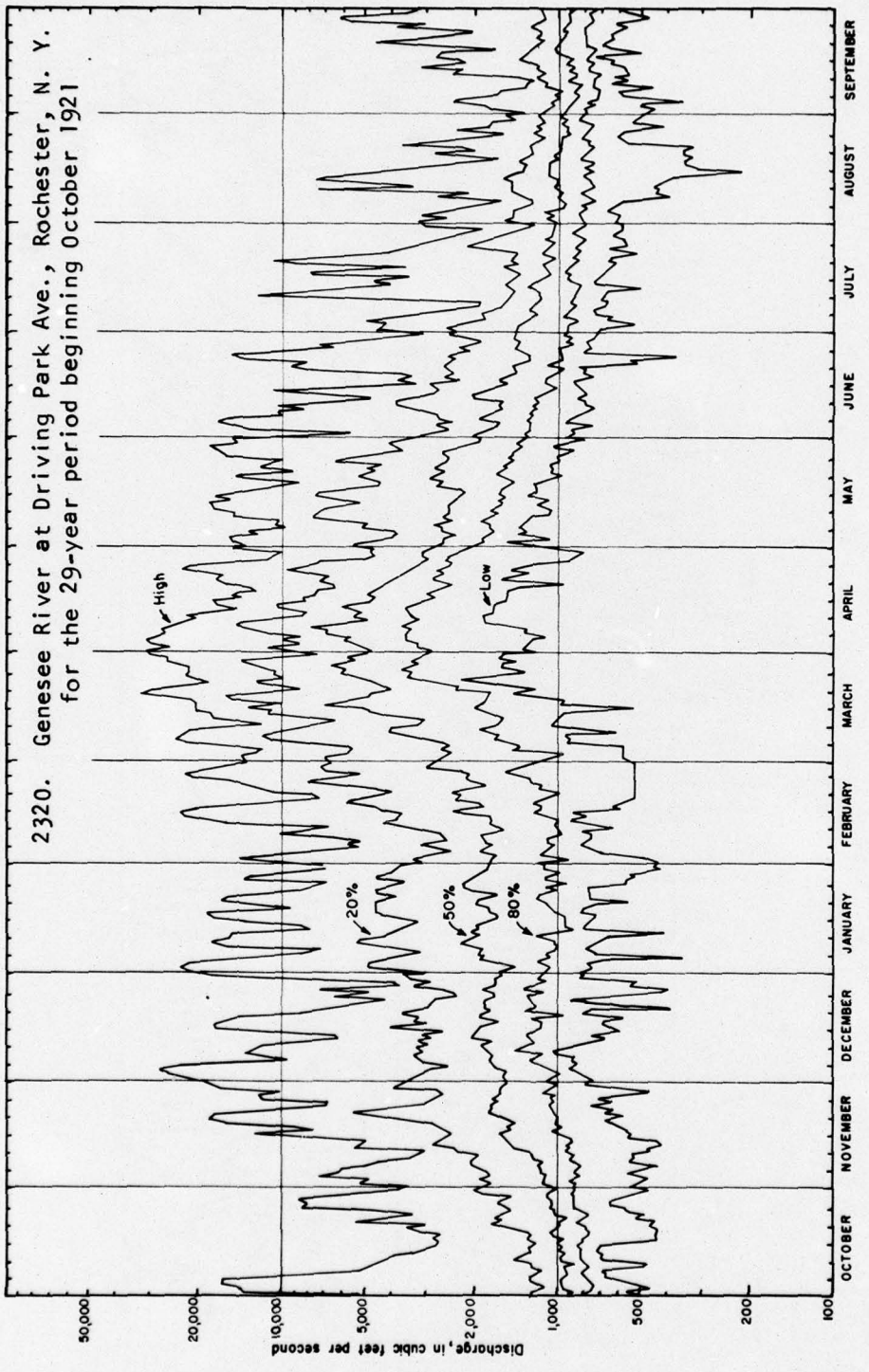
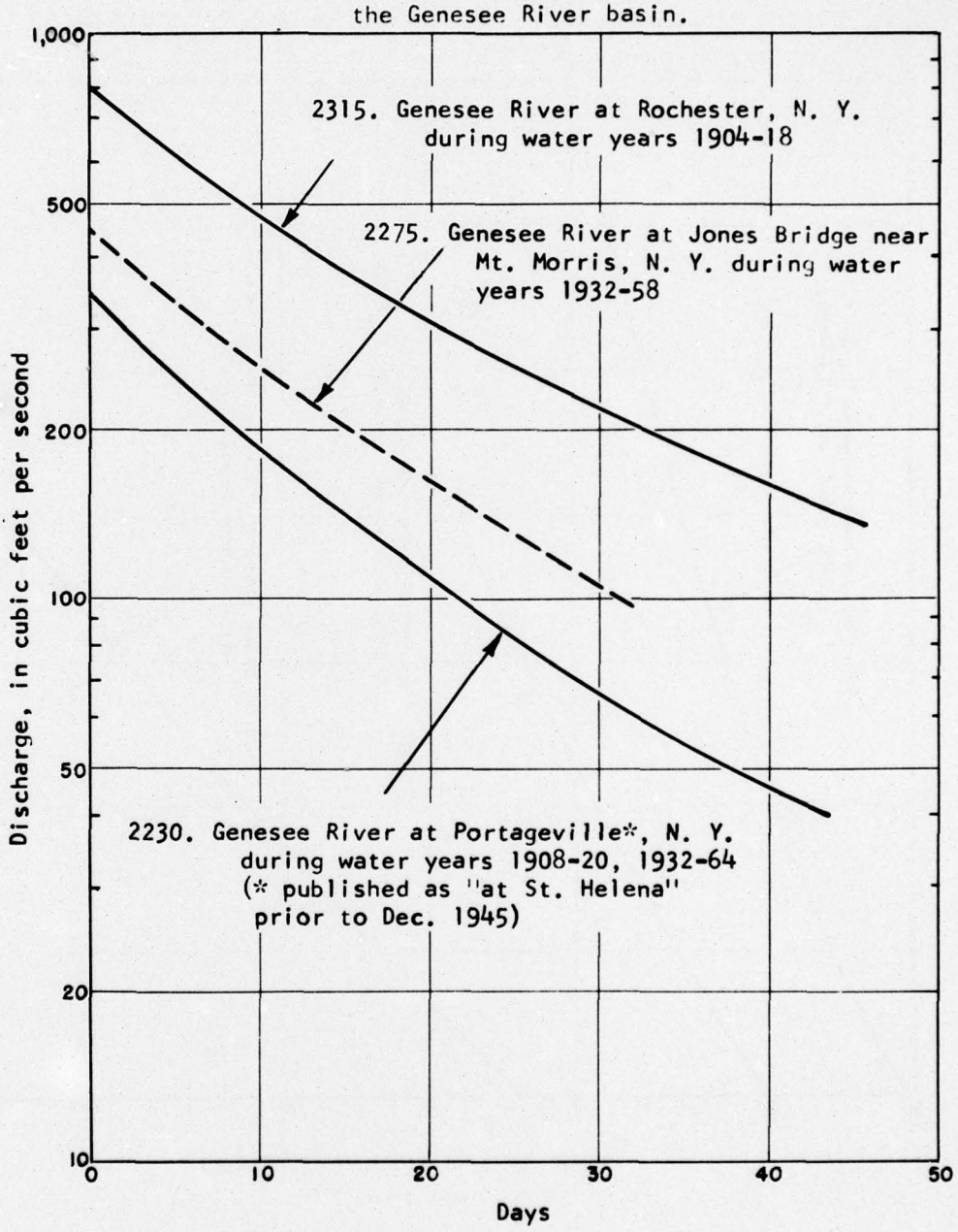
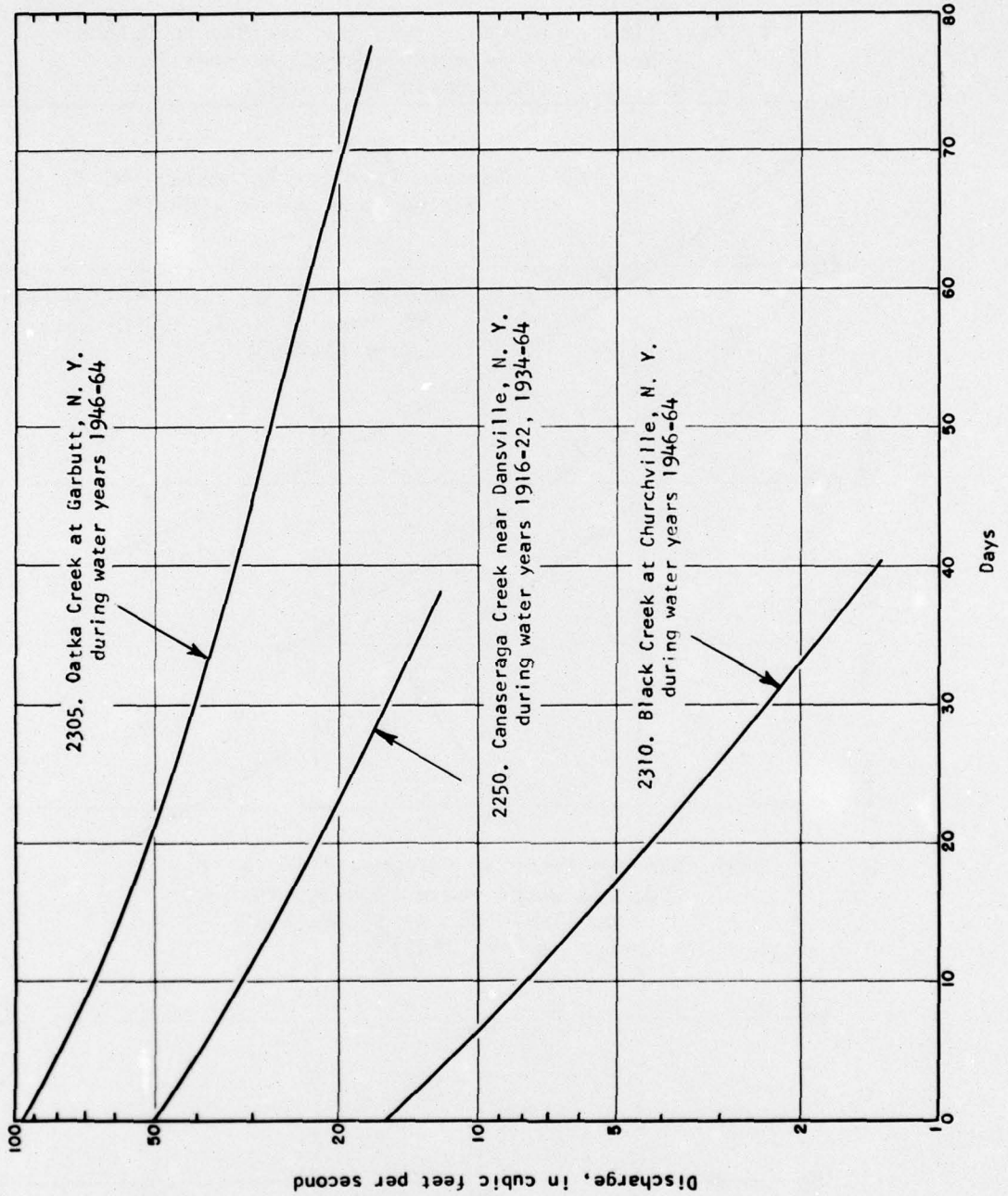
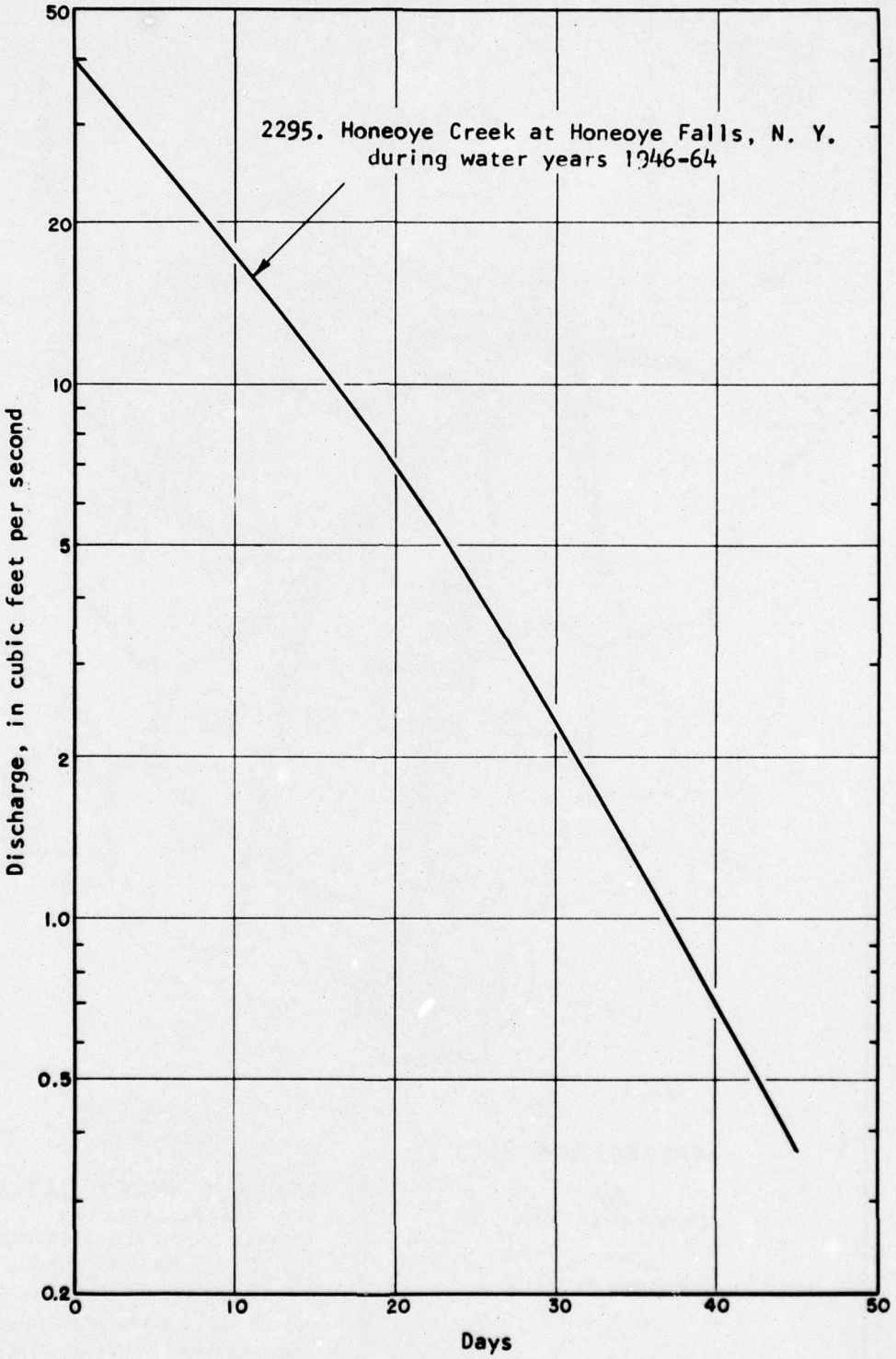

2320. Genesee River at Driving Park Ave., Rochester, N. Y.
for the 29-year period beginning October 1921
High
Low
20%
50%
80%
Discharge, in cubic feet per second
50,000
20,000
10,000
5,000
2,000
1,000
500
200
100
OCTOBER
NOVEMBER
DECEMBER
JANUARY
FEBRUARY
MARCH
APRIL
MAY
JUNE
JULY
AUGUST
SEPTEMBER

Base-flow recession curves for the May to October period for selected gaging stations in the Genesee River basin.

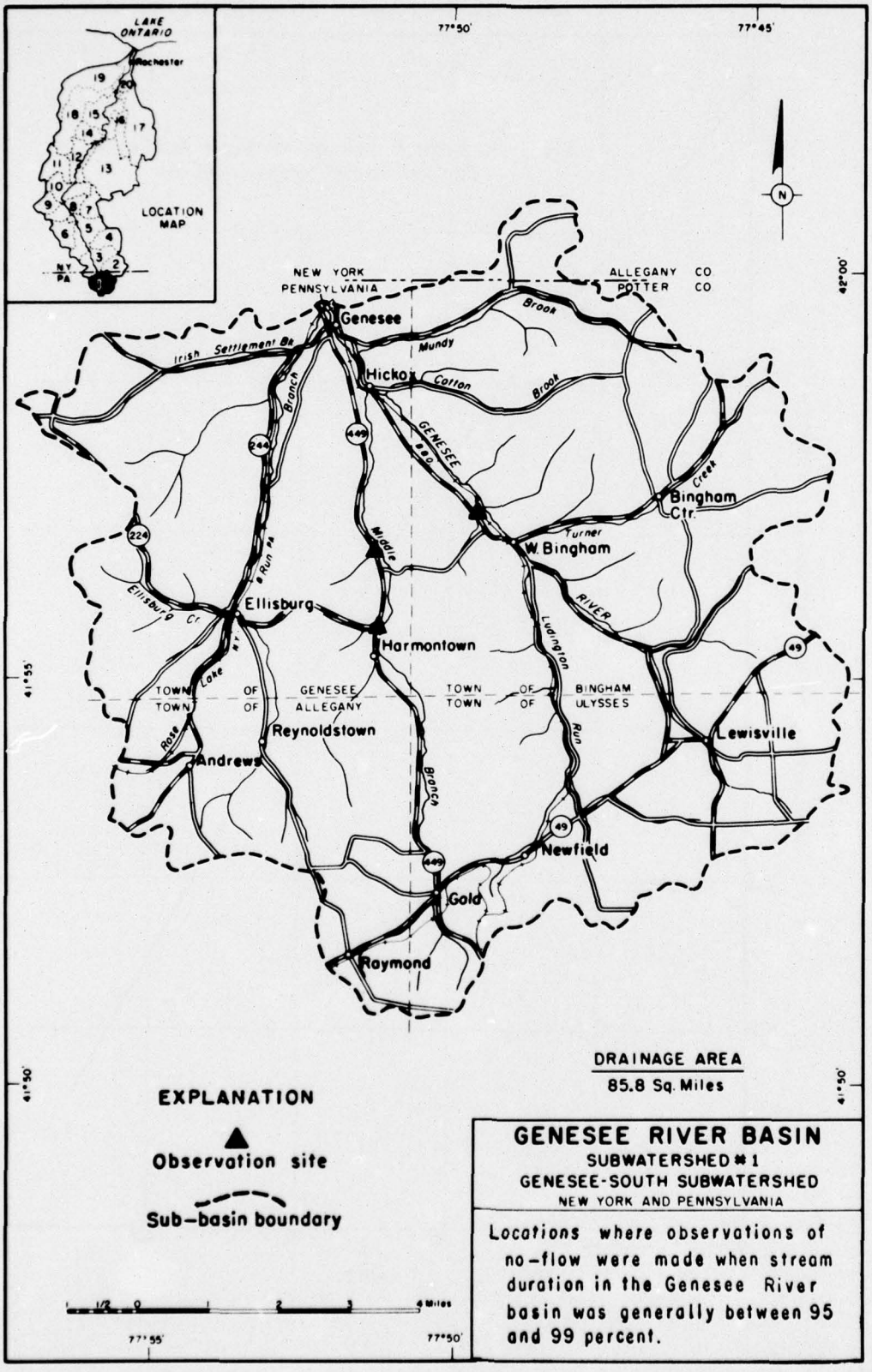


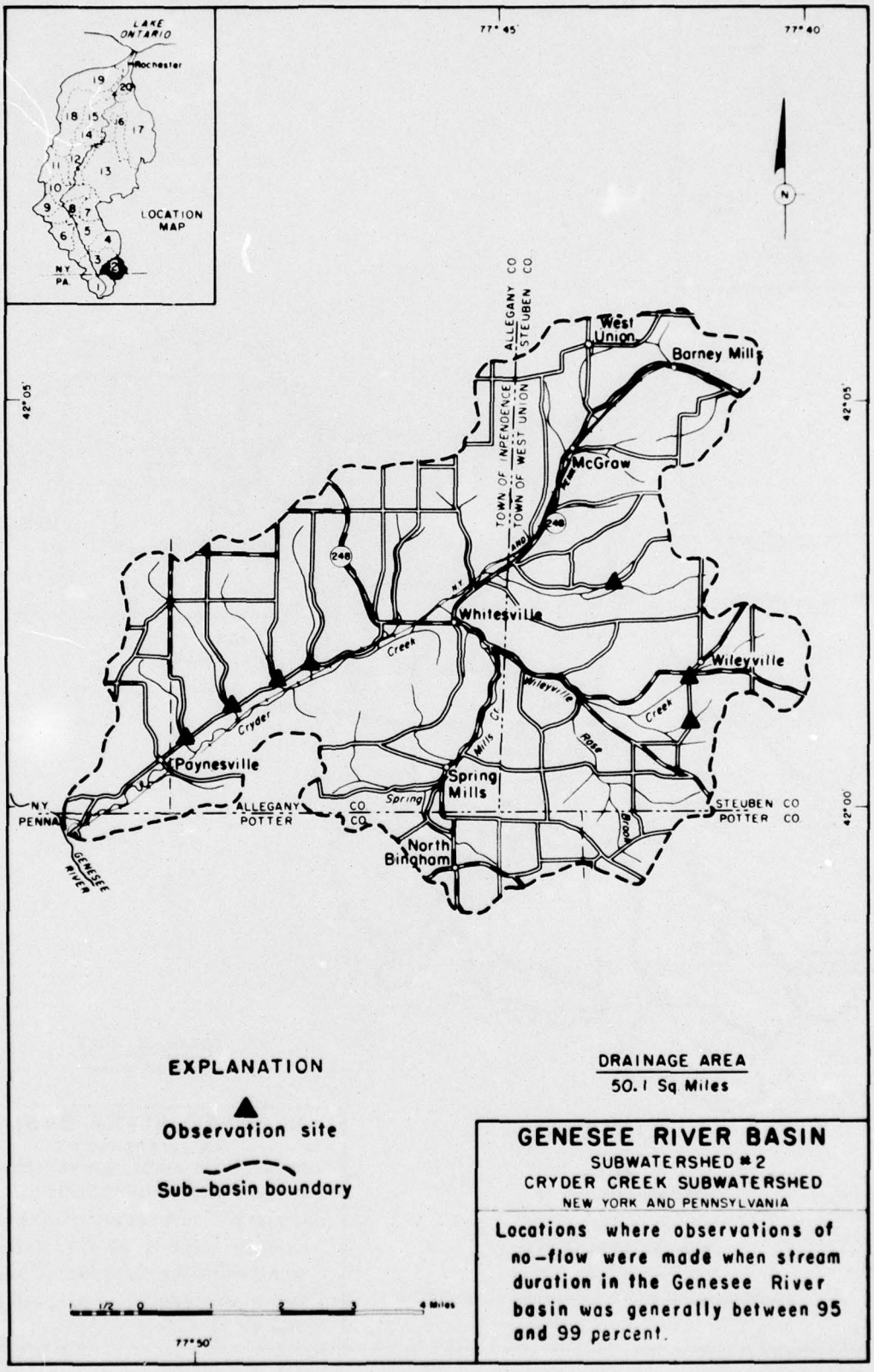

2305. Oatka Creek at Garbutt, N. Y.
during water years 1946-64
2250. Canaseraga Creek near Dansville, N. Y.
during water years 1916-22, 1934-64
2310. Black Creek at Churchville, N. Y.
during water years 1946-64
Discharge, in cubic feet per second
100
50
20
10
5
2
1
0
10
20
30
40
50
60
70
80
Days

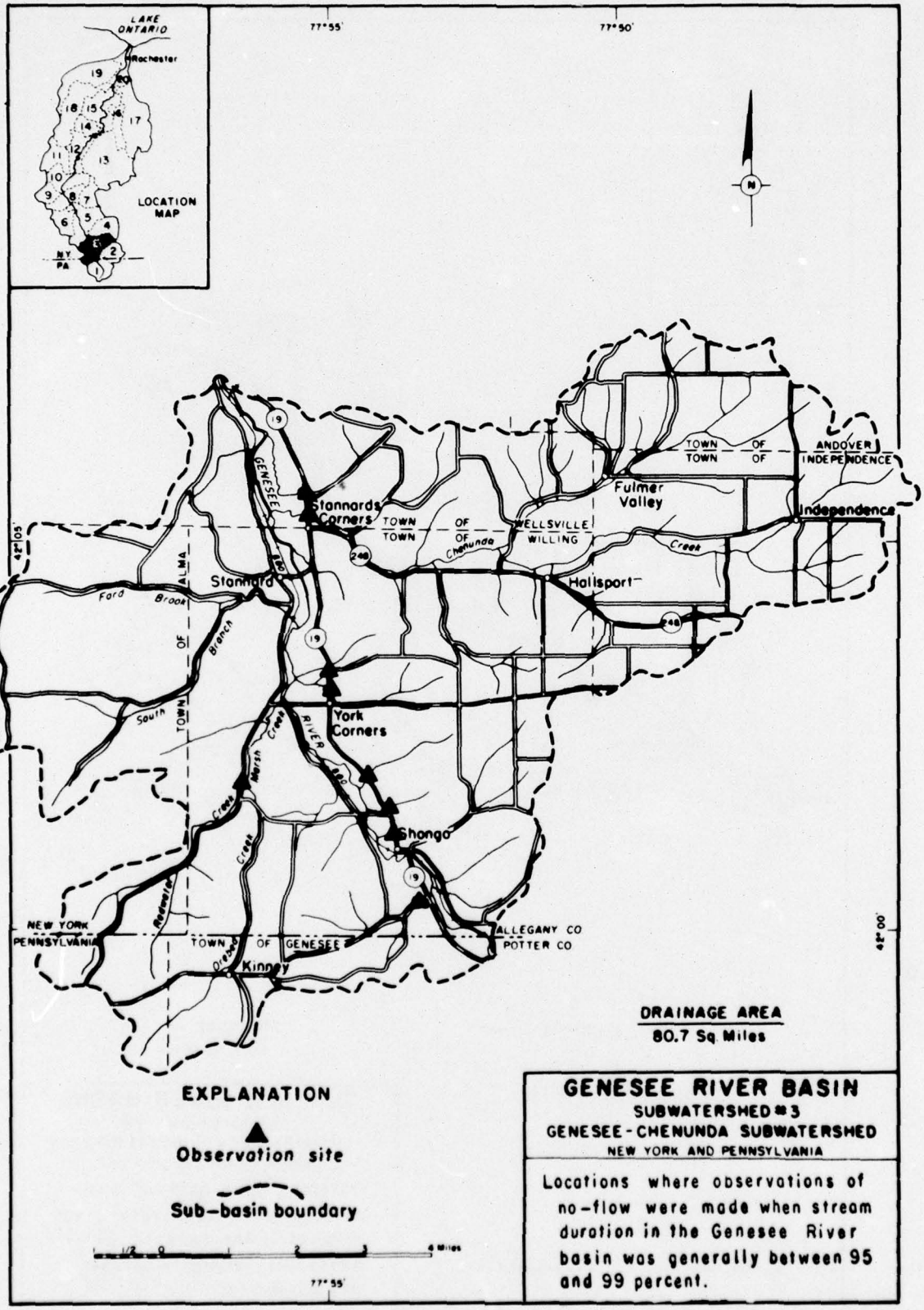

2295. Honeoye Creek at Honeoye Falls, N. Y.
during water years 1946-64
Discharge, in cubic feet per second
50
20
10
5
2
1.0
0.5
0.2
0
10
20
30
40
50
Days

APPENDIX SECTION V

Locations where observation of no flow were made when stream duration in the Genesee River basin was generally between 95 and 99 percent

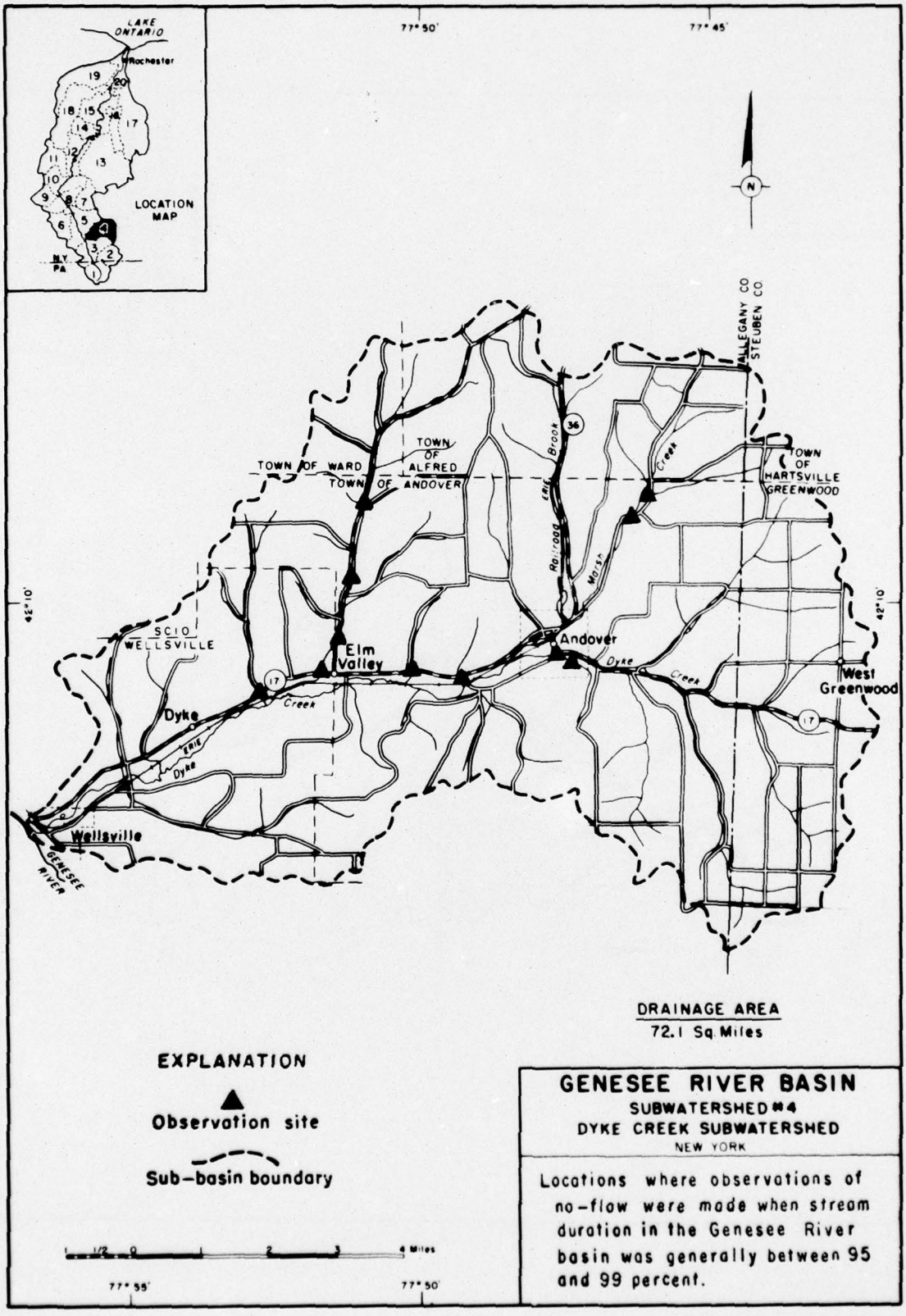



LAKE ONTARIO
Rochester
LOCATION MAP
NY
PA
77°45'
77°40'
42°05'
42°00'
N
ALLEGANY CO
STEUBEN CO
TOWN OF INDEPENDENCE
TOWN OF WEST UNION
West Union
Barney Mills
McGraw
248
Whitesville
Wiley Creek
Wileyville
Cryder Creek
Paynesville
Spring Mills
Spring Creek
Wiley Creek
Rose Brook
North Bingham
NY
PENNA
ALLEGANY CO
POTTER CO
STEUBEN CO
POTTER CO
GENESEE RIVER
EXPLANATION
Observation site
Sub-basin boundary
1/2 0 1 2 3 4 Miles
77°50'
DRAINAGE AREA
50.1 Sq Miles
GENESEE RIVER BASIN
SUBWATERSHED # 2
CRYDER CREEK SUBWATERSHED
NEW YORK AND PENNSYLVANIA
Locations where observations of no-flow were made when stream duration in the Genesee River basin was generally between 95 and 99 percent.



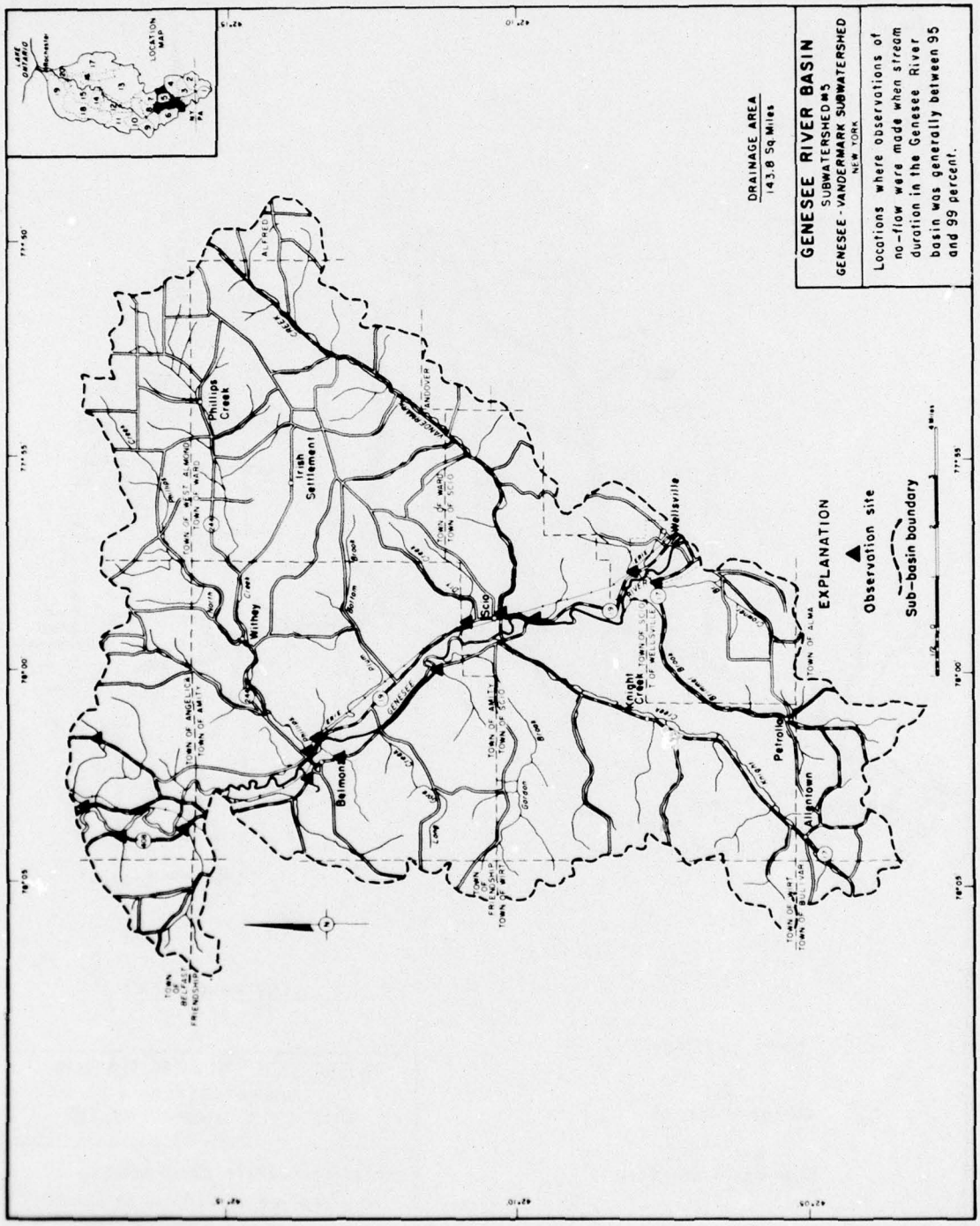
GENESEE RIVER BASIN
SUBWATERSHED #3
GENESEE - CHENUNDA SUBWATERSHED
NEW YORK AND PENNSYLVANIA

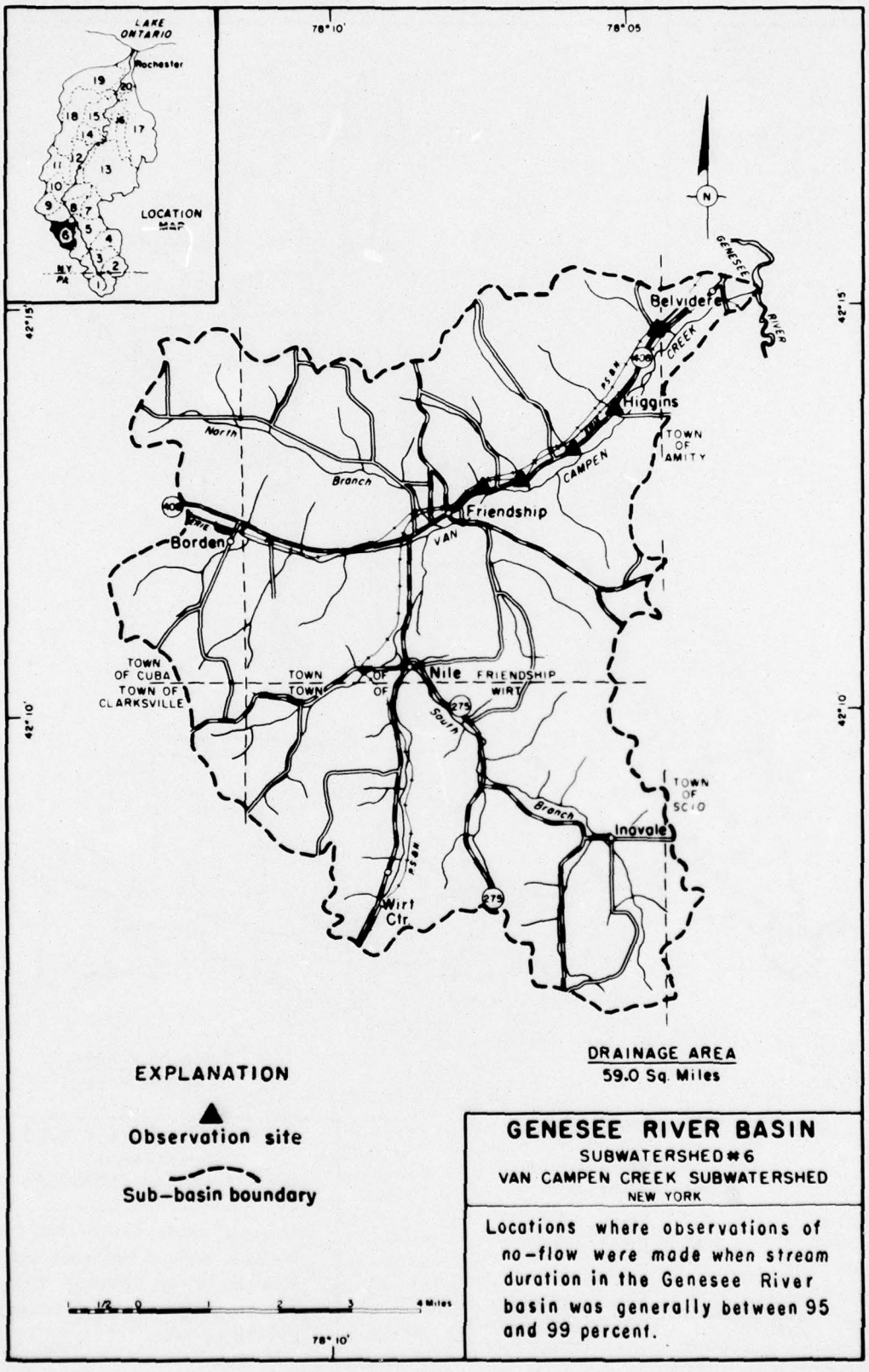
Locations where observations of no-flow were made when stream duration in the Genesee River basin was generally between 95 and 99 percent.

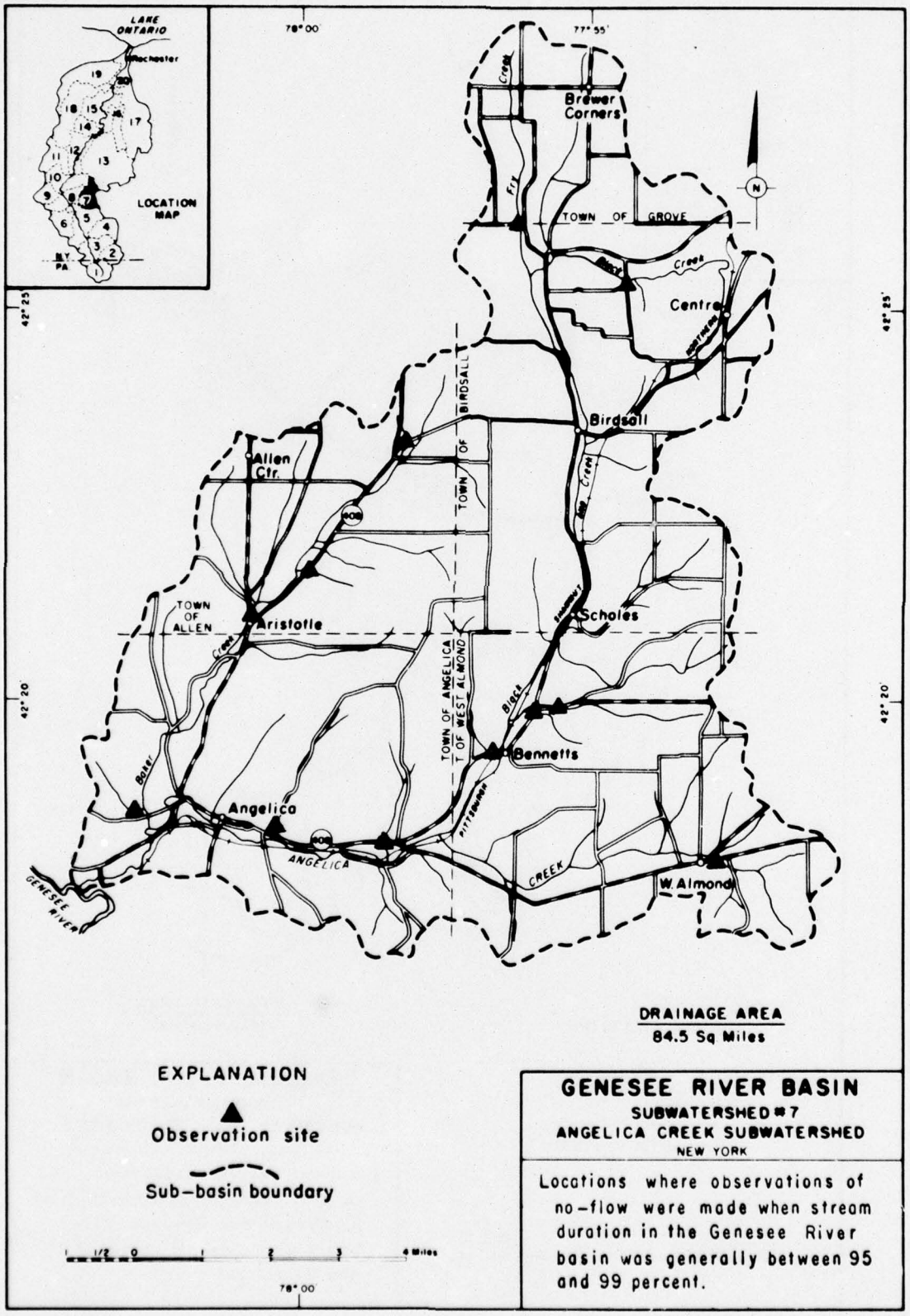


GENESEE RIVER BASIN
SUBWATERSHED #4
DYKE CREEK SUBWATERSHED
NEW YORK

Locations where observations of no-flow were made when stream duration in the Genesee River basin was generally between 95 and 99 percent.

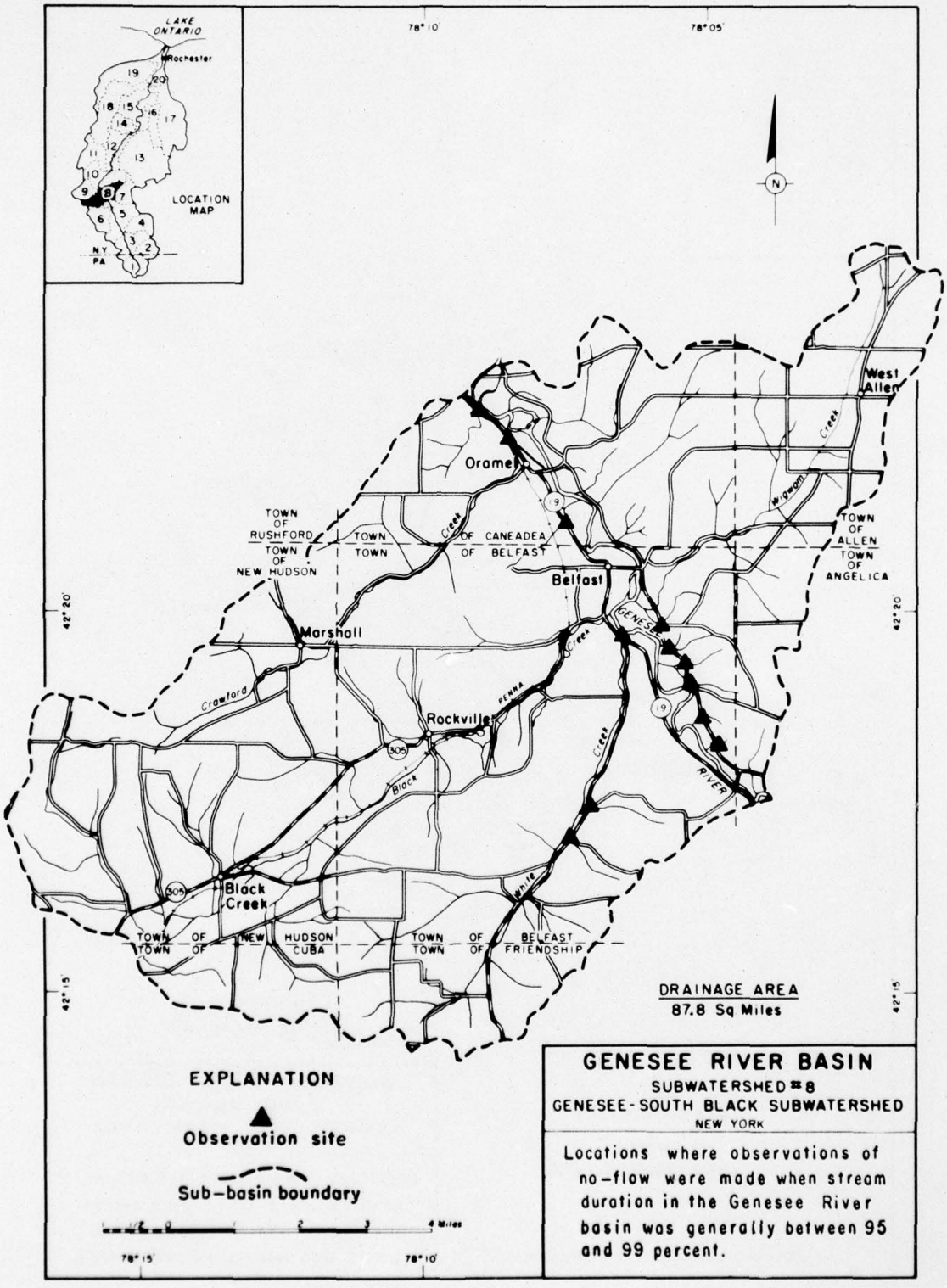

GENESEE RIVER BASIN
SUBWATERSHED #5
GENESEE - VANDERMARK SUBWATERSHED
NEW YORK
DRAINAGE AREA
143.8 Sq Miles
Locations where observations of no-flow were made when stream duration in the Genesee River basin was generally between 95 and 99 percent.
EXPLANATION
Observation site
Sub-basin boundary
LOCATION MAP
Phillips Creek
Irish Settlement
Wiley Creek
Scio
Wellsville
Belmont
Knight Creek
Petrolia
Allentown
Genesee River
Oil Creek
Vandermark Road
Scio Road
Belmont Road
Petrolia Road
Allentown Road
TOWN OF ALMA
TOWN OF SCIO
TOWN OF WIRT
TOWN OF ANGELICA
TOWN OF ALLEN
TOWN OF FRIENDSHIP
TOWN OF ALFRED
77°50
77°55
78°00
78°05
42°10
42°05

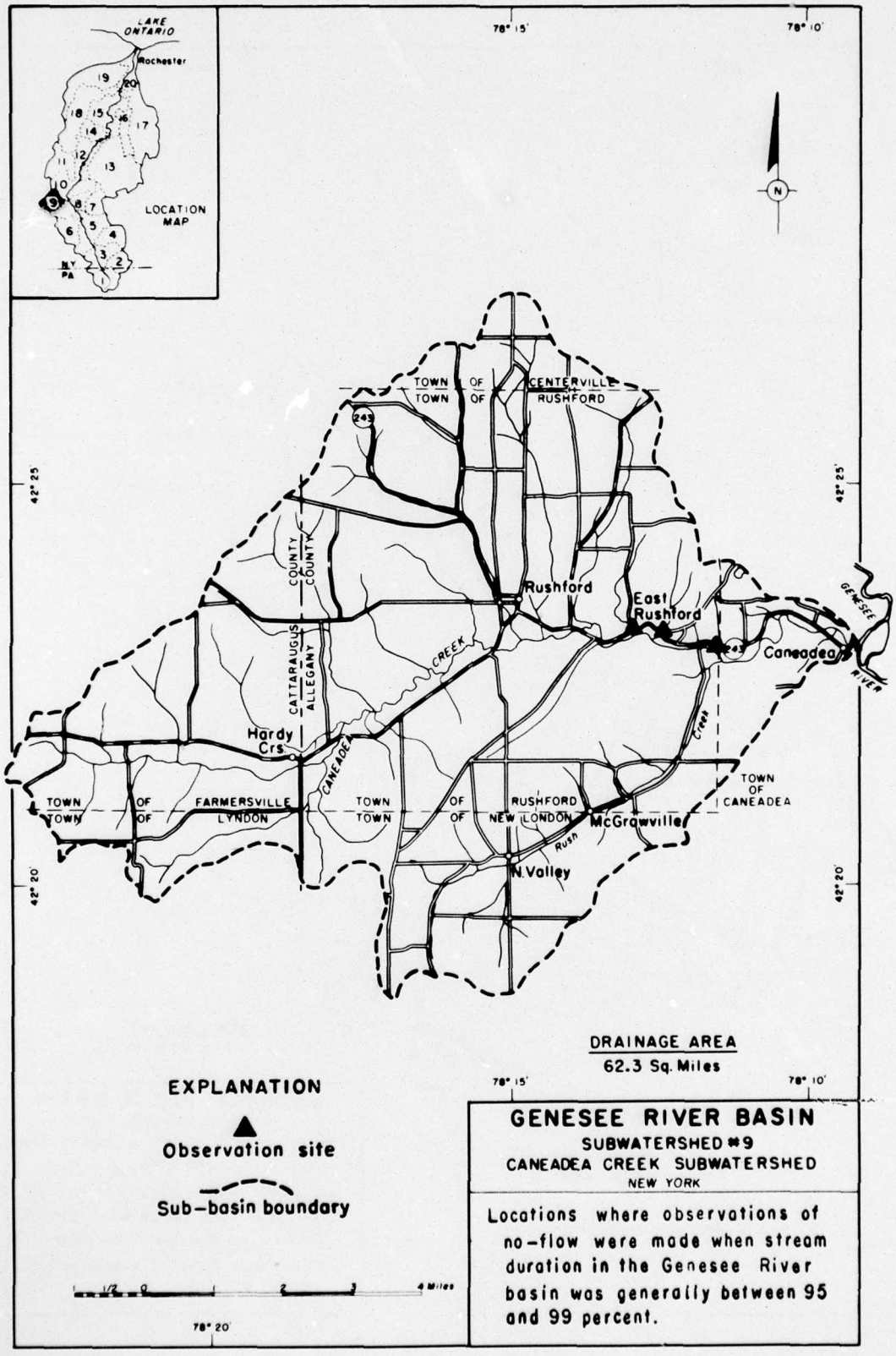

LAKE ONTARIO
Rochester
LOCATION MAP
NY
PA
78°10'
78°05'
42°15'
42°10'
N
Belvidere
GENESEE RIVER
CREEK
Higgins
North
Branch
CAMPEN
TOWN OF AMITY
Friendship
VAN
Borden
TOWN OF CUBA
TOWN OF CLARKSVILLE
TOWN OF NILE
TOWN OF FRIENDSHIP
WIRT
South
Branch
Inovale
TOWN OF SCIO
Wirt Ctr.
EXPLANATION
Observation site
Sub-basin boundary
DRAINAGE AREA
59.0 Sq. Miles
GENESEE RIVER BASIN
SUBWATERSHED #6
VAN CAMPEN CREEK SUBWATERSHED
NEW YORK
Locations where observations of no-flow were made when stream duration in the Genesee River basin was generally between 95 and 99 percent.
1/2 0 1 2 3 4 Miles

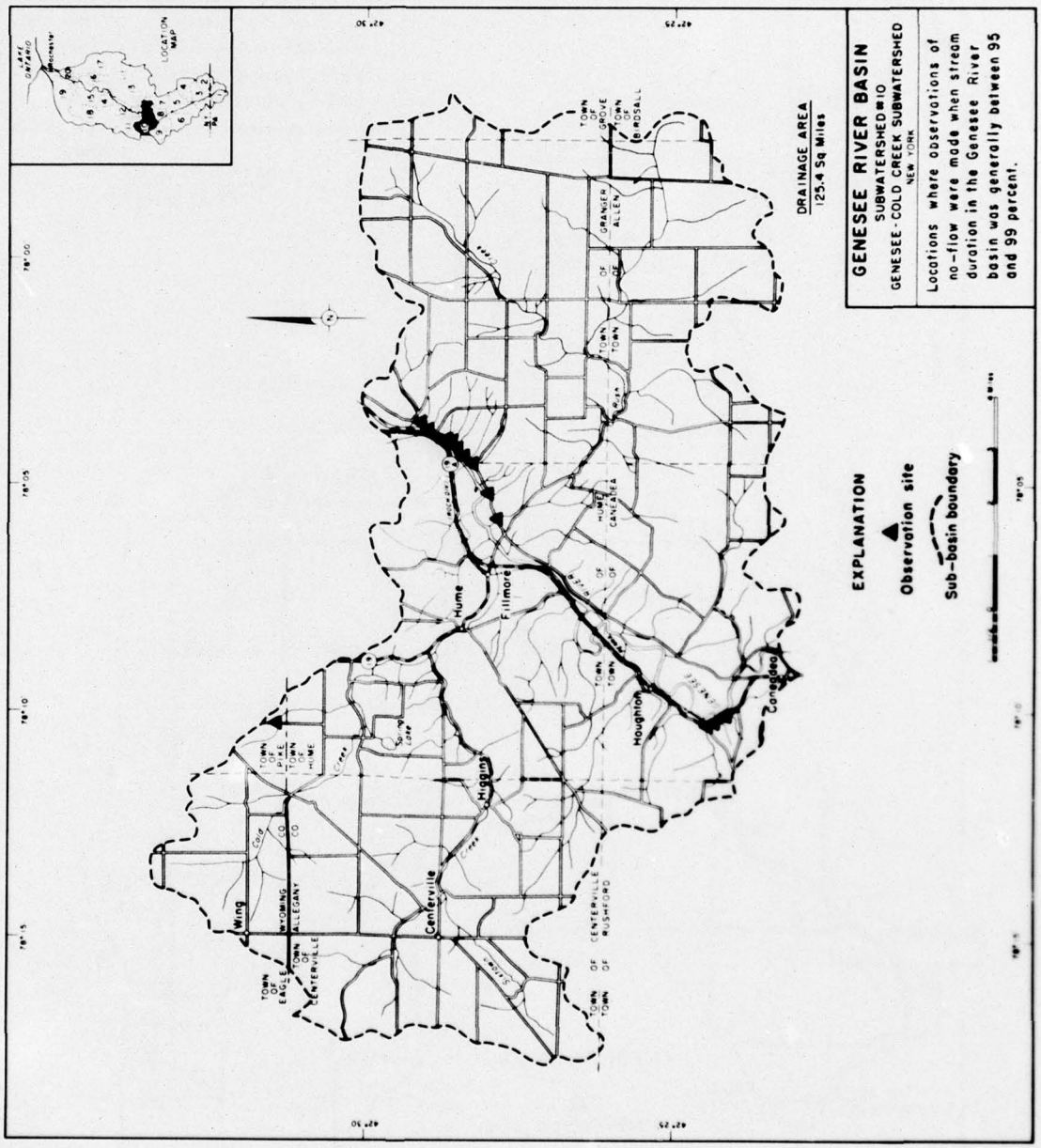


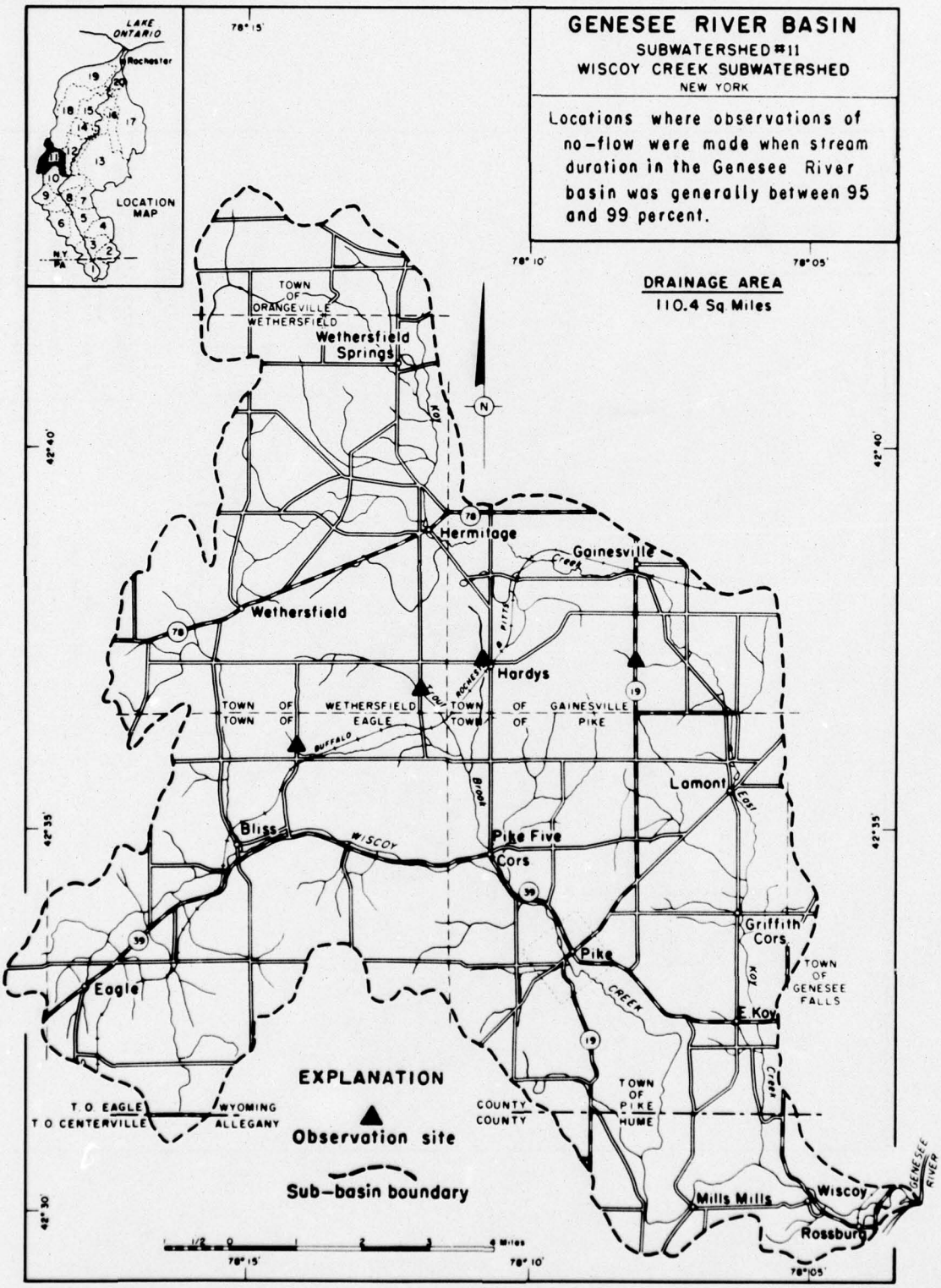
GENESEE RIVER BASIN
SUBWATERSHED #7
ANGELICA CREEK SUBWATERSHED
NEW YORK

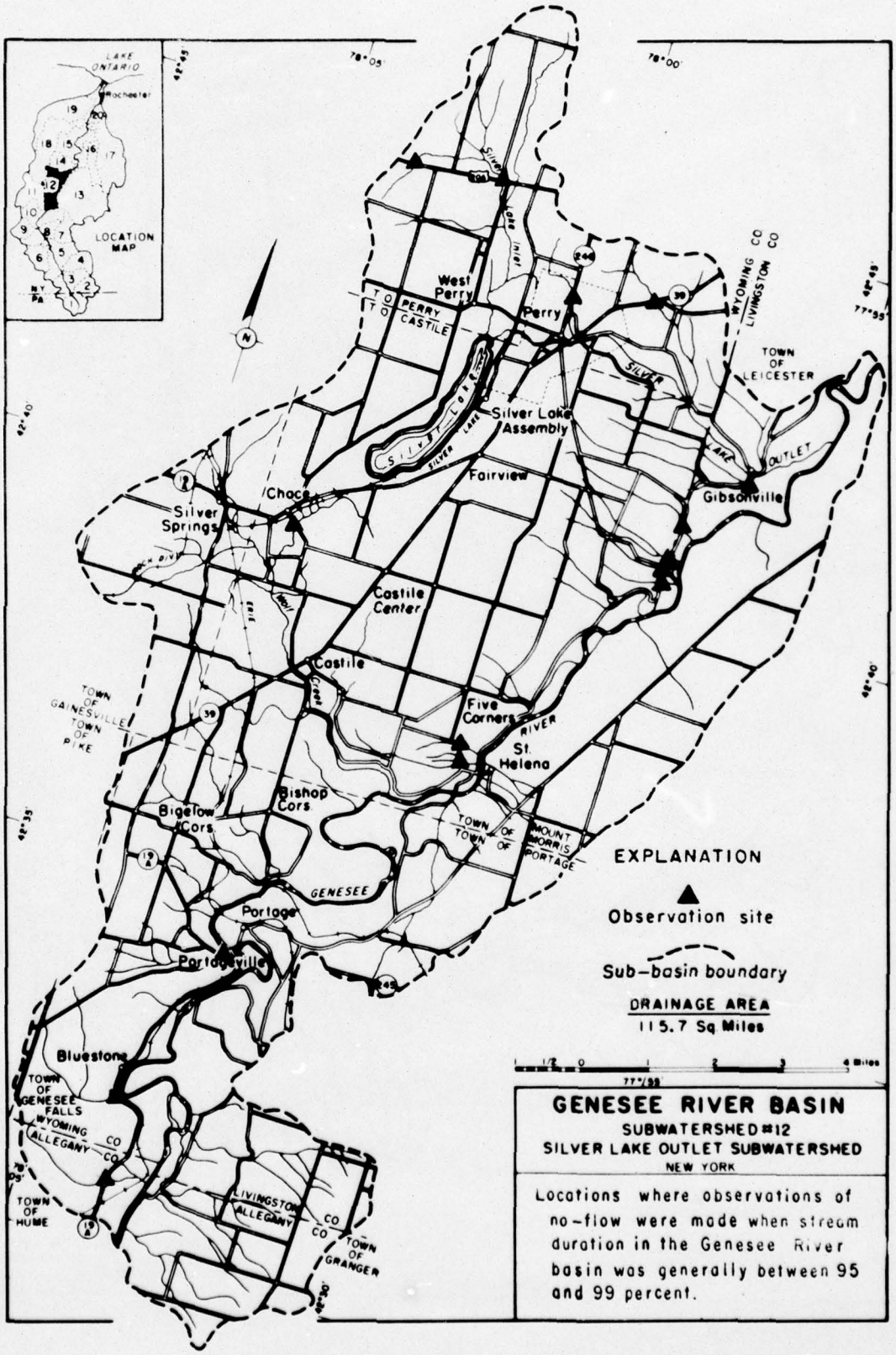
Locations where observations of no-flow were made when stream duration in the Genesee River basin was generally between 95 and 99 percent.

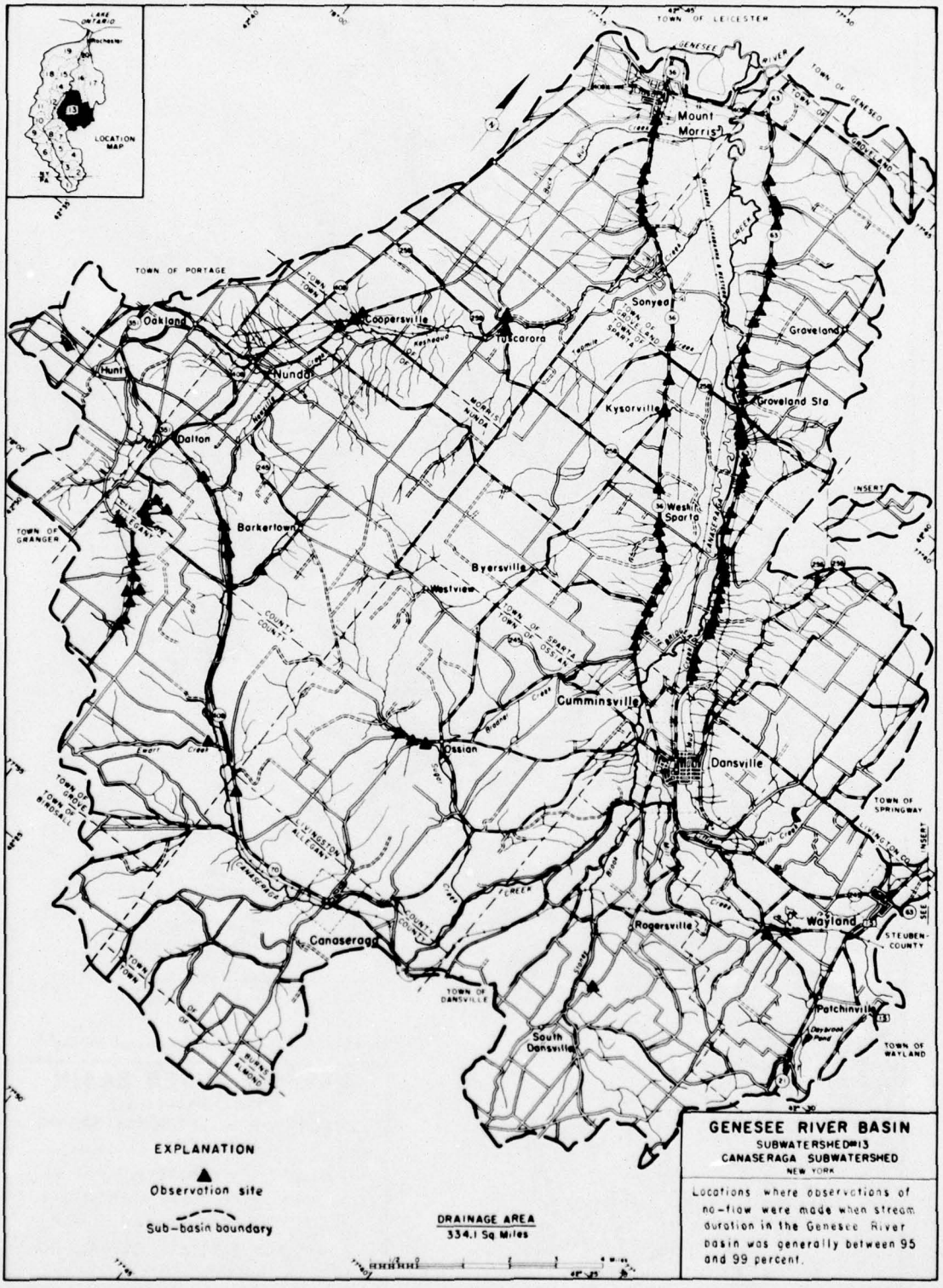

LAKE ONTARIO
Rochester
LOCATION MAP
NY
PA
78°10'
78°05'
42°20'
42°15'
N
West Allen
Creek
Wiscoy
Orame
TOWN OF RUSHFORD
TOWN OF NEW HUDSON
TOWN OF CANEADEA
TOWN OF BELFAST
TOWN OF ALLEN
TOWN OF ANGELICA
Belfast
Marshall
Genesee
Crawford
Rockville
Penna
Creek
Black
River
Black Creek
White
TOWN OF NEW HUDSON
TOWN OF CUBA
TOWN OF BELFAST
TOWN OF FRIENDSHIP
DRAINAGE AREA
87.8 Sq Miles
EXPLANATION
Observation site
Sub-basin boundary
0 1 2 3 4 Miles
GENESEE RIVER BASIN
SUBWATERSHED #8
GENESEE-SOUTH BLACK SUBWATERSHED
NEW YORK
Locations where observations of no-flow were made when stream duration in the Genesee River basin was generally between 95 and 99 percent.

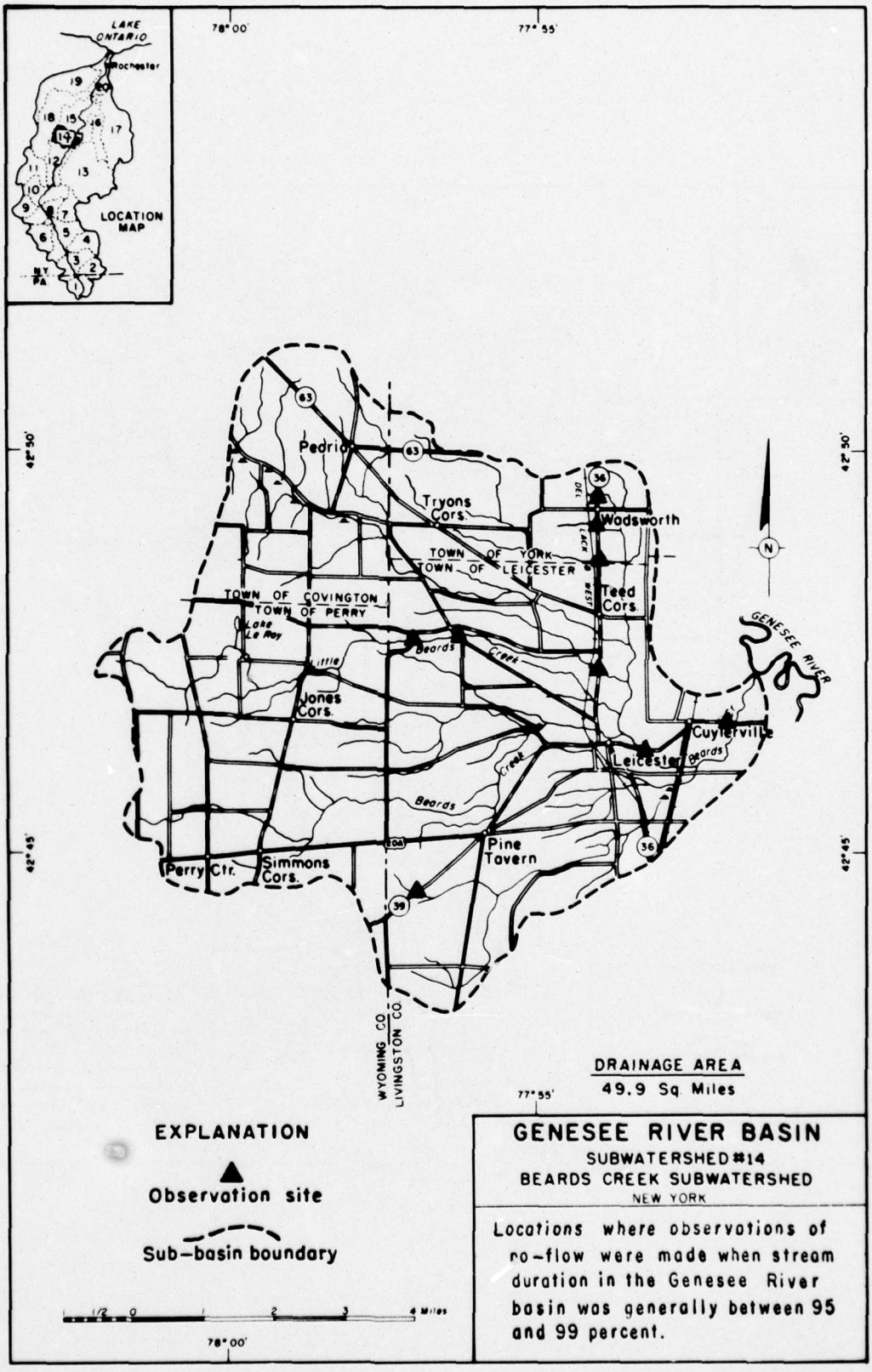

LAKE ONTARIO
Rochester
LOCATION MAP
NY
PA
78° 15'
78° 10'
42° 25'
42° 20'
78° 20'
TOWN OF CENTERVILLE
TOWN OF RUSHFORD
COUNTY
COUNTY
CATTARAUGUS
ALLEGANY
CREEK
Rushford
East Rushford
Caneadea
GENESEE
RIVER
Hardy Crs
CANEADEA
Creek
TOWN OF FARMERSVILLE
TOWN OF LYNDON
TOWN OF RUSHFORD
TOWN OF NEW LONDON
TOWN OF CANEADEA
McGrawville
Rush
N. Valley
DRAINAGE AREA
62.3 Sq. Miles
EXPLANATION
Observation site
Sub-basin boundary
4 Miles
GENESEE RIVER BASIN
SUBWATERSHED #9
CANEADEA CREEK SUBWATERSHED
NEW YORK
Locations where observations of no-flow were made when stream duration in the Genesee River basin was generally between 95 and 99 percent.

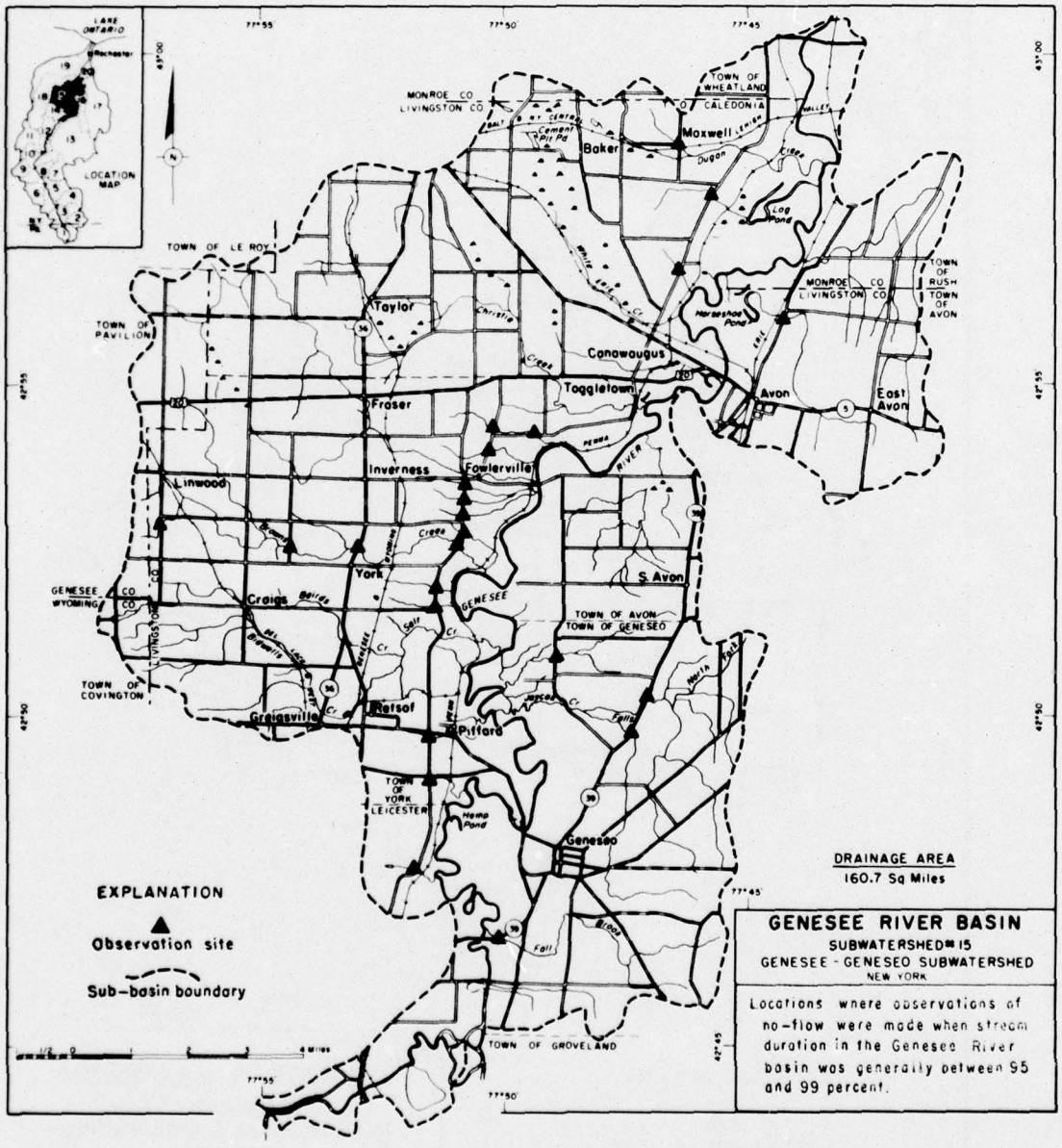

GENESEE RIVER BASIN
SUBWATERSHED #10
GENESEE - COLD CREEK SUBWATERSHED
NEW YORK
Locations where observations of no-flow were made when stream duration in the Genesee River basin was generally between 95 and 99 percent.
DRAINAGE AREA
125.4 Sq Miles
EXPLANATION
Observation site
Sub-basin boundary
LOCATION MAP
LAKE ONTARIO
Wing
Centerville
Higgins
Hume
Fillmore
Houghton
Dansville
TOWN OF EAGLE
TOWN OF CENTERVILLE
WYOMING COUNTY
ALLEGANY COUNTY
TOWN OF PIKE
TOWN OF HUME
TOWN OF CENTERVILLE
TOWN OF RUSHFORD
TOWN OF GROVE
TOWN OF ROSS
TOWN OF GRANGER
TOWN OF ALLEN
TOWN OF
TOWN OF
TOWN OF
TOWN OF
TOWN OF
TOWN OF
HUME CANEADEA
Cold Creek
Caneadea Creek
Genesee River
Oatka Creek
Spring Creek
Canaseraga Creek
42°30
42°25
78°00
78°05
78°10
78°15

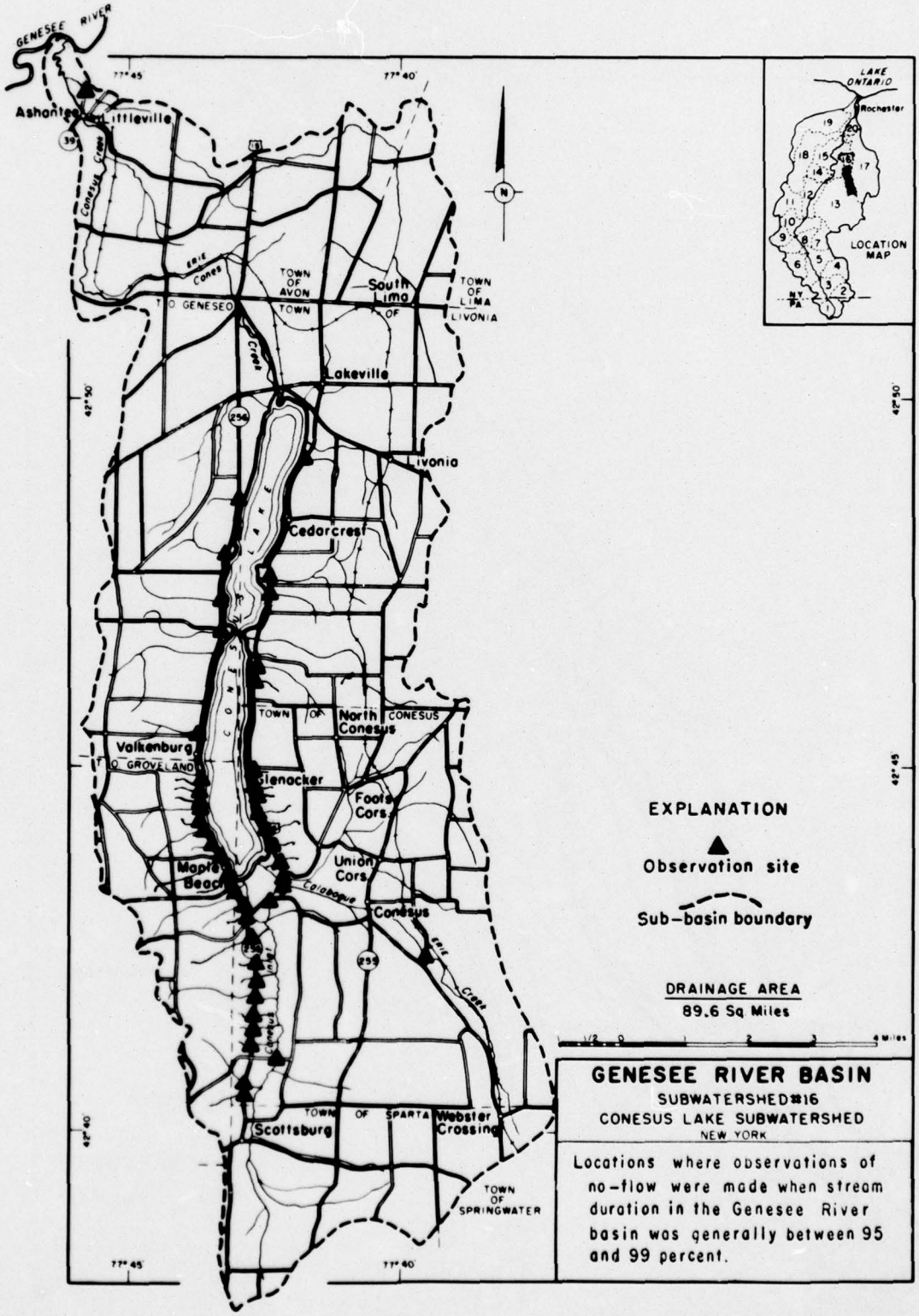

GENESEE RIVER BASIN
SUBWATERSHED #11
WISCOY CREEK SUBWATERSHED
NEW YORK
Locations where observations of no-flow were made when stream duration in the Genesee River basin was generally between 95 and 99 percent.
DRAINAGE AREA
110.4 Sq Miles
LAKE ONTARIO
Rochester
LOCATION MAP
NY
Pa
78°15'
78°10'
78°05'
42°40'
42°35'
42°30'
TOWN OF ORANGEVILLE
WETHERSFIELD
Wethersfield Springs
Hermitage
Gainesville
Wethersfield
Hardys
TOWN OF WETHERSFIELD
TOWN OF EAGLE
TOWN OF GAINESVILLE
TOWN OF PIKE
Lamont
Bliss
Pike Five Cors
Griffith Cors
Pike
Eagle
TOWN OF GENESEE FALLS
E Koy
EXPLANATION
Observation site
Sub-basin boundary
T O EAGLE
T O CENTERVILLE
WYOMING COUNTY
ALLEGANY COUNTY
TOWN OF PIKE
HUME
Mills Mills
Wiscoy
Rossburg
GENESEE RIVER
Miles

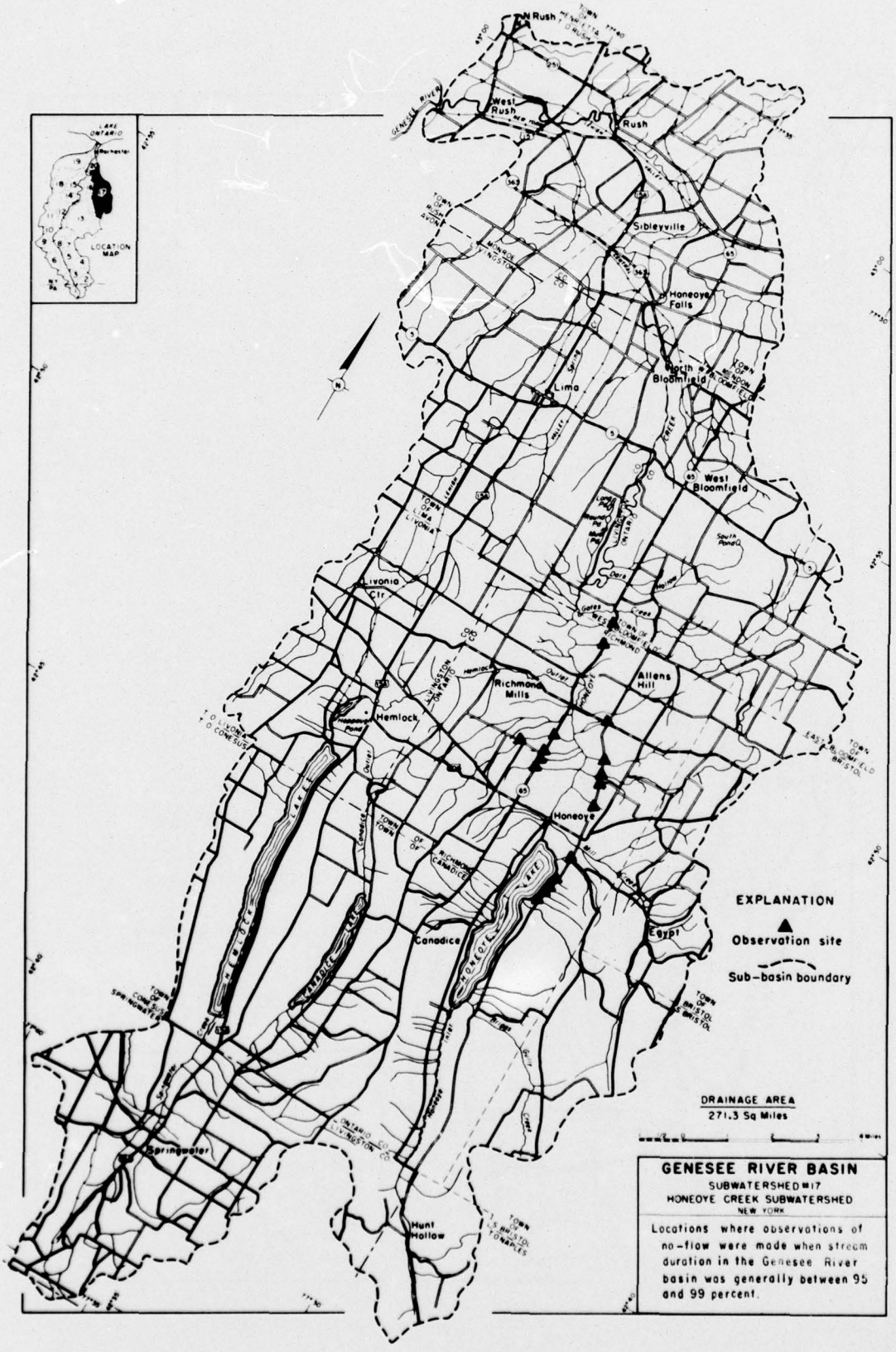

LAKE ONTARIO
Rochester
LOCATION MAP
NY
PA
West Perry
Perry
TOWN OF PERRY
TOWN OF CASTILE
Silver Lake Assembly
Fairview
Chaca
Silver Springs
Castile Center
Castile
Five Corners
St. Helena
Bishop Corners
Bigelow Corners
Portage
Portageville
Bluestone
Gibsonville
TOWN OF LEICESTER
WYOMING CO
LIVINGSTON CO
TOWN OF GAINESVILLE
TOWN OF PIKE
TOWN OF MOUNT MORRIS
TOWN OF PORTAGE
TOWN OF GENESEE FALLS
WYOMING CO
ALLEGANY CO
TOWN OF HUME
LIVINGSTON CO
ALLEGANY CO
TOWN OF GRANGER
GENESEE RIVER
SILVER LAKE OUTLET
EXPLANATION
Observation site
Sub-basin boundary
DRAINAGE AREA
115.7 Sq Miles
GENESEE RIVER BASIN
SUBWATERSHED #12
SILVER LAKE OUTLET SUBWATERSHED
NEW YORK
Locations where observations of no-flow were made when stream duration in the Genesee River basin was generally between 95 and 99 percent.

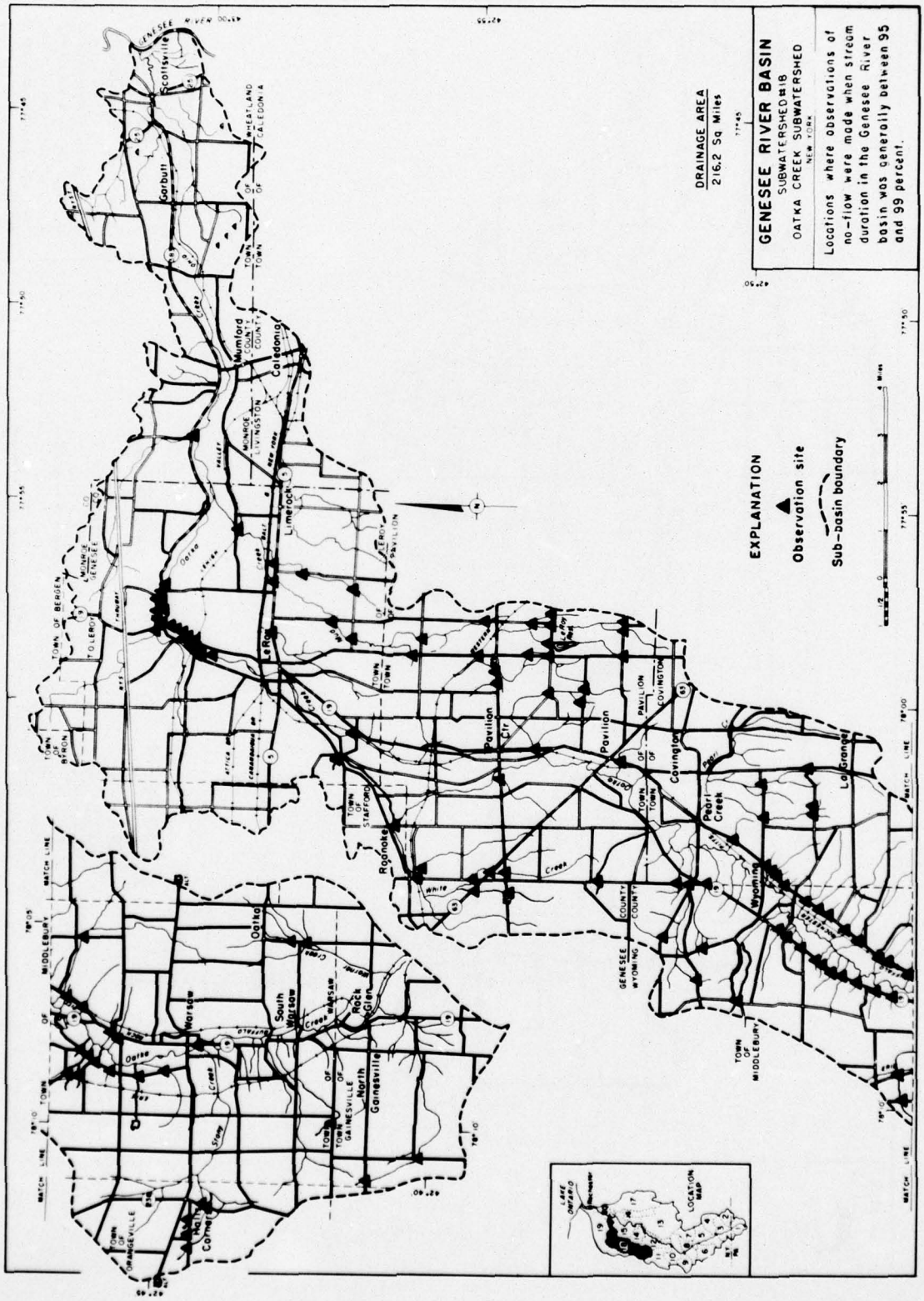

LOCATION MAP
TOWN OF LEICESTER
GENESEE RIVER
Mount Morris
TOWN OF PORTAGE
Oakland
Coopersville
Tuscarora
Sonyea
Hunt
Nunda
Keshequa Creek
Genesee Valley Canal
Groveland
Kysorville
Groveland Sta
Dalton
Barkerlown
TOWN OF GRANGER
Wesha Sparta
INSERT
Byersville
Westview
COUNTY
Cumminsville
Ossian
Dansville
TOWN OF SPRINGWAY
TOWN OF GROVE
TOWN OF BIRDSALL
Canaseraga
Rogersville
Wayland
STEUBEN COUNTY
TOWN OF DANSVILLE
Patchinville
South Dansville
TOWN OF WAYLAND
EXPLANATION
Observation site
Sub-basin boundary
DRAINAGE AREA
334.1 Sq Miles
GENESEE RIVER BASIN
SUBWATERSHED#13
CANASERAGA SUBWATERSHED
NEW YORK
Locations where observations of no-flow were made when stream duration in the Genesee River basin was generally between 95 and 99 percent.

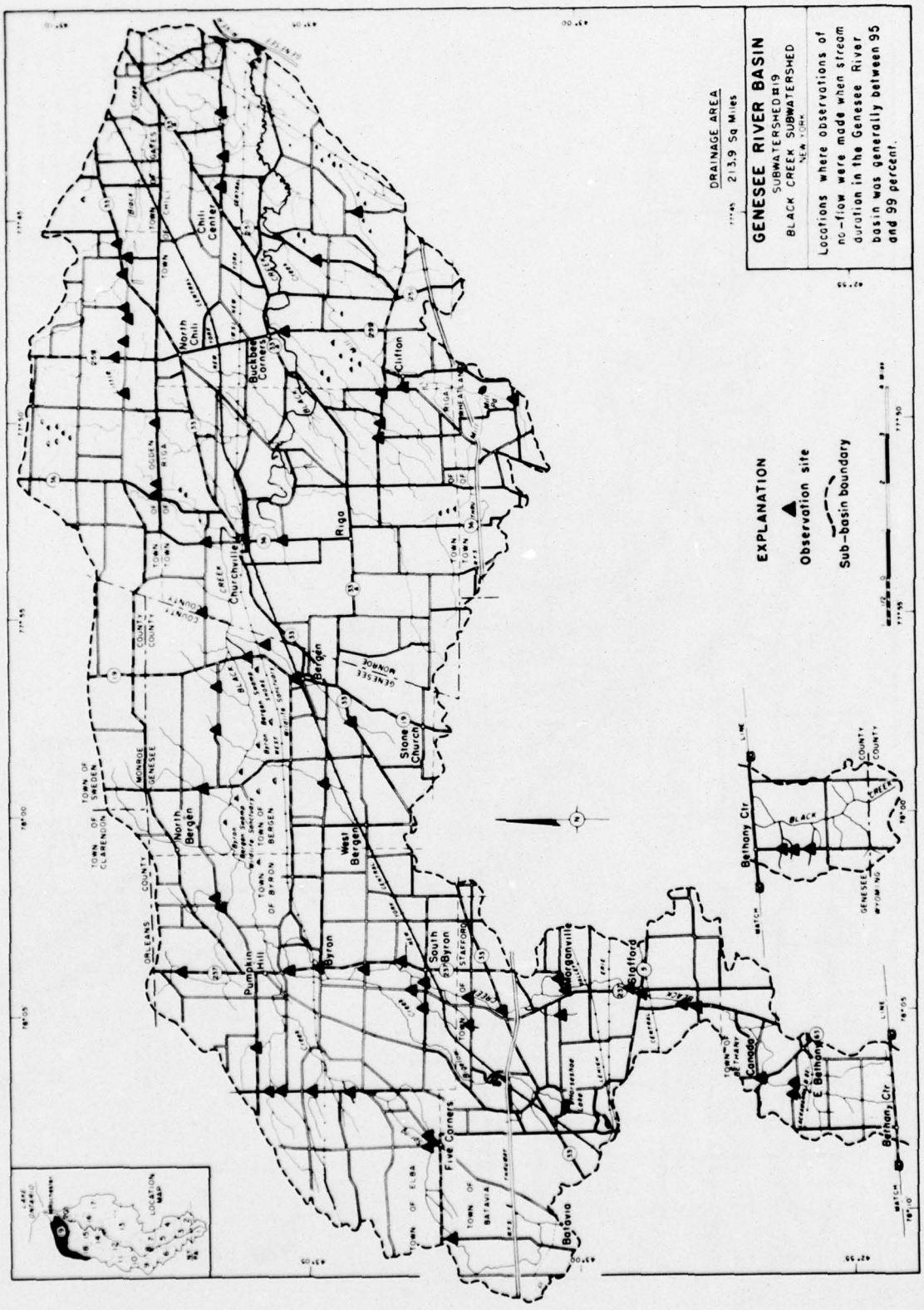

LAKE ONTARIO
Rochester
LOCATION MAP
NY
PA
78°00'
77°55'
42°50'
42°45'
Pedrick
Tryons Cors.
Wadsworth
TOWN OF YORK
TOWN OF LEICESTER
Teed Cors
TOWN OF COVINGTON
TOWN OF PERRY
Lake Le Roy
Little Beards Creek
Jones Cors.
GENESEE RIVER
Cuylerville
Leicester
Beards Creek
Pine Tavern
Perry Ctr.
Simmons Cors.
WYOMING CO.
LIVINGSTON CO.
DRAINAGE AREA
49.9 Sq Miles
EXPLANATION
Observation site
Sub-basin boundary
1/2 0 1 2 3 4 Miles
GENESEE RIVER BASIN
SUBWATERSHED #14
BEARDS CREEK SUBWATERSHED
NEW YORK
Locations where observations of no-flow were made when stream duration in the Genesee River basin was generally between 95 and 99 percent.

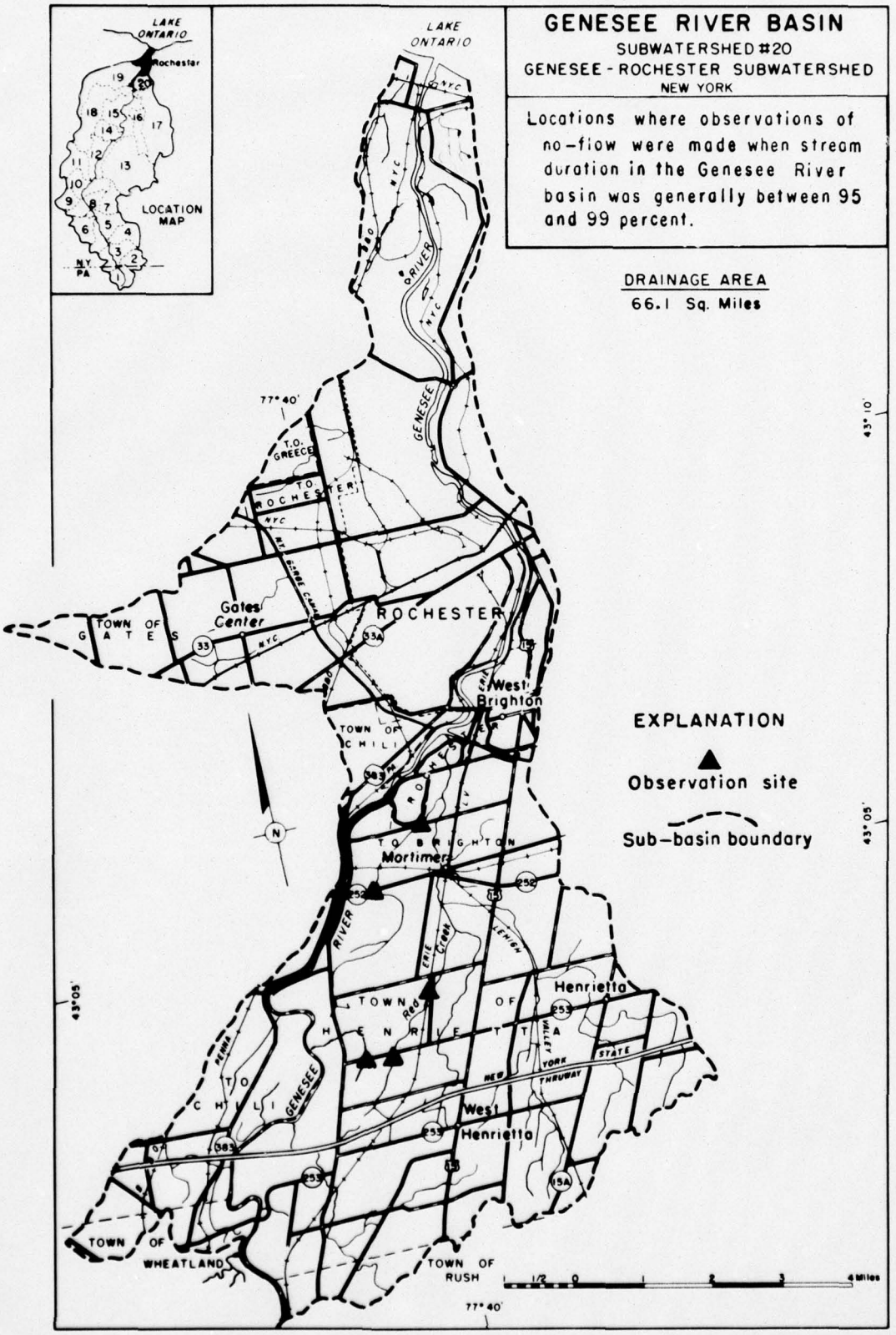

LAKE ONTARIO
LOCATION MAP
77°55'
77°50'
77°45'
43°00'
42°55'
42°50'
MONROE CO
LIVINGSTON CO
TOWN OF WHEATLAND
CALEDONIA
Maxwell
Baker
Cement Pit Pd
Log Pond
TOWN OF LE ROY
TOWN OF PAVILION
Taylor
Christie Creek
Conawaugus
Toggletown
Fraser
Inverness
Fowlerville
Linwood
Avon
East Avon
Horseshoe Pond
TOWN OF RUSH
TOWN OF AVON
Hemlock Creek
York
S. Avon
Craigs
Beards Creek
Gulf Cr.
GENESEE CO
WYOMING CO
LIVINGSTON CO
TOWN OF AVON
TOWN OF GENESEO
TOWN OF COVINGTON
Groveville
Retsof
Piffard
Mill Creek
Jaycox Cr.
TOWN OF YORK
LEICESTER
Hemlock Pond
Geneseo
Fall Brook
TOWN OF GROVELAND
EXPLANATION
Observation site
Sub-basin boundary
DRAINAGE AREA
160.7 Sq Miles
GENESEE RIVER BASIN
SUBWATERSHED № 15
GENESEE - GENESEO SUBWATERSHED
NEW YORK
Locations where observations of no-flow were made when stream duration in the Genesee River basin was generally between 95 and 99 percent.


GENESEE RIVER
Ashantee
Littleville
Conesus Creek
Erie Canal
TOWN OF GENESEO
TOWN OF AVON
South Lima
TOWN OF LIMA
LIVONIA
Creek
Lakeville
Ivonia
Cedarcrest
LAKE
TOWN OF North Conesus CONESUS
Volkenburg
GROVELAND
Glenacker
Foots Cors
Maple Beach
Union Cors
Conesus
Creek
Scottsburg
TOWN OF SPARTA
Webster Crossing
TOWN OF SPRINGWATER
77°45
77°40
42°50
42°45
42°40
LAKE ONTARIO
Rochester
LOCATION MAP
N.Y.
PA
EXPLANATION
Observation site
Sub-basin boundary
DRAINAGE AREA
89.6 Sq Miles
GENESEE RIVER BASIN
SUBWATERSHED #16
CONESUS LAKE SUBWATERSHED
NEW YORK
Locations where observations of no-flow were made when stream duration in the Genesee River basin was generally between 95 and 99 percent.


Rush
West Rush
Rush
Sibleyville
Honeoye Falls
North Bloomfield
Lima
West Bloomfield
Livonia
Richmond Mills
Allens Hill
Hemlock
Honeoye
Canadice
Egypt
Springwater
Hunt Hollow
LOCATION MAP
EXPLANATION
Observation site
Sub-basin boundary
DRAINAGE AREA
271.3 Sq Miles
GENESEE RIVER BASIN
SUBWATERSHED #17
HONEOYE CREEK SUBWATERSHED
NEW YORK
Locations where observations of no-flow were made when stream duration in the Genesee River basin was generally between 95 and 99 percent.


GENESEE RIVER BASIN
SUBWATERSHED #18
OATKA CREEK SUBWATERSHED
NEW YORK
Locations where observations of no-flow were made when stream duration in the Genesee River basin was generally between 95 and 99 percent.
DRAINAGE AREA
216.2 Sq Miles
EXPLANATION
Observation site
Sub-basin boundary
LOCATION MAP
Scottsville
Garbutt
Mumford
Caledonia
LeRoy
Pavilion
Covington
Pearl Creek
LaGrange
Oatka
South Warsaw
Rock Glen
North Gainesville
Gainesville
Warsaw
Rochester
Batavia
Buffalo


GENESEE RIVER BASIN
SUBWATERSHED #19
BLACK CREEK SUBWATERSHED
NEW YORK
Locations where observations of no-flow were made when stream duration in the Genesee River basin was generally between 95 and 99 percent.
DRAINAGE AREA
213.9 Sq Miles
EXPLANATION
Observation site
Sub-basin boundary
Chili Center
North Chili
Buckbee Corners
Clifton
Rigo
Churchville
Bergen
Stone Church
North Bergen
West Bergen
Byron
Pumpkin Hill
South Byron
Five Corners
Batavia
Morganville
Stafford
Bethany Ctr
E Bethany
Bethany Ctr
Caledo
BLACK CREEK
GENESEE
MONROE
ORLEANS
COUNTY
TOWN OF SWEDEN
TOWN OF CLARENDON
TOWN OF BYRON
TOWN OF BERGEN
TOWN OF ELBA
TOWN OF BATAVIA
TOWN OF STAFFORD
LOCATION MAP


GENESEE RIVER BASIN
SUBWATERSHED #20
GENESEE - ROCHESTER SUBWATERSHED
NEW YORK
Locations where observations of no-flow were made when stream duration in the Genesee River basin was generally between 95 and 99 percent.
DRAINAGE AREA
66.1 Sq. Miles
LAKE ONTARIO
Rochester
LOCATION MAP
NY
PA
EXPLANATION
Observation site
Sub-basin boundary
ROCHESTER
Gates Center
West Brighton
Mortimer
Henrietta
West Henrietta
TOWN OF GATES
TOWN OF CHILI
TOWN OF HENRIETTA
TOWN OF WHEATLAND
TOWN OF RUSH
TO GREECE
TO ROCHESTER
TO BRIGHTON
GENESEE RIVER
GENESEE
ERIE CANAL
NEW YORK THRUWAY
STATE
77°40'
43°10'
43°05'
N
1/2 0 1 2 3 4 Miles

ATTACHMENT B for APPENDIX H (Water Supply

and Water Quality Management)

of the

GENESEE RIVER BASIN COMPREHENSIVE STUDY

WATER QUALITY IMPROVEMENT COSTS

IN THE GENESEE RIVER BASIN

Prepared Jointly by

FEDERAL WATER POLLUTION CONTROL ADMINISTRATION

LAKE ONTARIO PROGRAM OFFICE

and

NEW YORK STATE DEPARTMENT OF HEALTH

DIVISION OF PURE WATERS

MAY 1967

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WATER QUALITY IMPROVEMENT COSTS

A. Introduction

The improvements necessary to achieve and maintain adequate water quality will entail large outlays of money by communities and industries. Most of the improvements involved are waste treatment facilities which require sizable capital expenditures for construction and are costly to operate and maintain.

This chapter presents the estimated cost of treatment facilities which have been identified as immediate improvement projects that should be in operation at the earliest practicable date. Costs of advanced waste treatment facilities, flow regulation, and other alternative improvements have also been estimated and are discussed.

Benefits resulting from water quality improvements are relatively easy to identify and describe. However, the methodology for assigning dollar values is not well developed and leaves much to be desired. Except for special techniques utilized in quantifying benefits for multipurpose reservoir projects, the benefits which are significant in determining the worth of proposed improvements are presented in descriptive terms. While this restricts the use of recognized benefits vs. cost and optimization techniques, there is recourse to that final test of "willingness to pay." This and other aspects will be examined in the discussion.

B. Municipal Treatment Costs

Costs of municipal waste treatemtn facilities have been determined in three categories of improvements as follows: (1) new primary and

secondary facilities for communities that have no treatment works, (2) expansion of present facilities at communities which now have primary treatment to provide good secondary treatment, and (3) advanced waste treatment facilities for communities where secondary treatment is not adequate for attaining stream quality goals. Table 10-1 gives the estimated total project costs for these improvements.

A total of 40 communities and sewer districts with a population of 500 or more need improvements to bring municipal waste treatment in the basin up to the recommended minimum level of treatment efficiency. Twenty-six of the communities have no sewers and will need complete collection systems. An estimated total of 25,000 people in communities of 500 population and larger are not connected to sewers. The cost of providing sewers where none exist will be several times greater than the cost of the treatment facilities. A very approximate estimate of necessary sewer construction indicates the cost will be about $9,000,000. This does not include main interceptors which are considered separately as part of total project costs in obtaining Federal and State construction grants.

Referring to Table X-1, the anticipated funds available from Federal and State construction grants programs are shown for each category. Assuming these funds are made available timely, and in the amounts shown, the communities will have to obtain the amounts in the last column by local financing. In addition to the costs for new facilities and expansions, there will be additional monies needed to construct main interceptor sewers. These are difficult to estimate without preliminary engineering studies by engineering firms. A rough approximation for interceptor cost is about $3,000,000.

Total costs for immediately needed municipal sewers and sewage treatment facilities are summarized:

	Estimated Cost	Anticipated Fund Source: Federal and State Grants	Anticipated Fund Source: Local Funds
Treatment facilities	$11,500,000	$ 8,050,000	$ 3,450,000
Intercepting sewers*	3,000,000	2,100,000	900,000
Collecting Sewers*	9,000,000	-	9,000,000
Totals	$23,500,000	$10,150,000	$13,350,000

* approximated costs

C. Industrial Waste Treatment Costs

The approximate costs of waste treatment and other control measures for industries with separate discharges in the Genesee River Basin are summarized as follows:

	Description	Amount
1.	Primary and secondary biological treatment facilities.	$15,000,000
2.	Non-biological facilities - neutralization, precipitation, etc.	500,000
3.	Advanced waste treatment (Birdseye Division - General Foods)	500,000
4.	Effluent pipeline, outfall and pumping station (Eastman Kodak)	8,000,000
	Total	$24,000,000

Item No. 1, estimated at $15,000,000, includes $11,000,000 for the costs at three industries with the largest organic waste production. Costs were determined on a basis similar to that used for estimating the cost of municipal waste treatment facilities. Costs for Item 2 were ap-

proximated on the basis of volumes requiring treatment, and need refinement after the specific treatment techniques are identified.

Advanced waste treatment costs for Birdseye Division, Item 3, are included since the unregulated flow of the Genesee River is not adequate, even with good secondary treatment of the industry's waste. Present engineering studies by consulting engineers are expected to determine the best method for treating this waste combined with the waste from the Village of Avon.

Secondary treatment of Eastman Kodak's waste is not adequate for stream quality maintenance and piping the effluent to Lake Ontario is the least expensive alternative.

D. Multi-purpose Reservoir Projects

The use of multi-purpose reservoir storage for water quality control was investigated in connection with the Comprehensive River Basin Study coordinated by the U.S. Corps of Engineers. There are seven locations where stream quality could be enhanced by releases from storage if reservoir sites under study prove economically feasible for development. Various alternative methods of achieving water quality objectives were investigated for each of the locations. Initial project costs and total annual costs were determined for the purpose of selecting the least costly alternative. Table 10-2 presents the average annual costs for debt repayment, interest, operation and maintenance.

In the last column of Table 10-2 the least costly alternate is indicated. It should be noted that individual projects undertaken as single purpose ventures would have to be adjusted upwards to reflect local interest rates for whatever type of financing might be employed. The

costs in the table were provided to the U.S. Corps of Engineers and the U.S. Soil Conservation Service for use in project evaluations.

Average annual costs were derived for specific use in benefit-cost analyses of proposed projects. Incorporation of storage for water quality control in each of the seven sectors in practicable, but final adoption of this improvement method at any of the locations is contingent upon approval by all interests involved and appropriation of necessary funds to proceed with construction. Until such time as projects are definitely assured, the costs for water quality maintenance in these locations will be based on the least expensive single purpose improvement projects.

E. Costs for Phosphate Control

The communities, industries and agricultural activities of the basin are the sources of a significant portion of the total input of nutrients that cause over-fertilization in Lake Ontario. The enrichment by nutrients promotes massive production of algae, which is the most serious water quality problem in the lake. Investigations reveal that restoration and protection of quality in the lake require deliberate and positive reduction of phosphorus inputs by application of control measures at the source. The costs for achieving a maximum reduction of phosphorus at waste treatment facilities have been estimated, and the total amount for this improvement in the Genesee Basin will be combined with the cost in other tributary basins to arrive at an overall cost of phosphate control for the lake.

For municipal waste treatment systems the addition of facilities to remove 90 percent or more of soluble phosphorus in raw wastes will entail a total capital expenditure of approximately $5,000,000. For separately

discharging industries the total cost is approximated at about $1,000,000. Feasible methods of reducing phosphorus from agricultural activities, and other sources which contribute to the total amount in land runoff, have not been identified and consequently no costs can be assigned at this time.

Table X-1

ESTIMATED COST OF MUNICIPAL TREATMENT IMPROVEMENTS

Item No.	Description	Total Population (present)	Total Cost of Improvements	Anticipated Grant Funds Federal*	Anticipated Grant Funds State	Local Funds Needed
1	Communities with no treatment facilities (32)	39,000	$ 6,000,000	$2,400,000	$1,800,000	$1,800,000
2	Communities and sewer districts needing expansion to secondary treatment (8)	62,000	4,500.000	1,800,000	1,350,000	1,350,000
3	Communities requiring advanced waste treatment (7)	(Included in items 1 & 2)	1,000,000	400,000	300,000	300,000
	Totals	101,000	$11,500,000	$4,600,000	$3,450,000	$3,450,000

* Federal share is assumed 40 percent of eligible project cost. This may be increased to 55 percent if certain conditions are met.

Table X-2

ANNUAL COST FOR ALTERNATIVE METHODS
STREAM QUALITY CONTROL

Stream Sector No.	Location	Average Annual Cost(1) Single Purpose Reservoir	Advanced Waste Treatment	Effluent Transport	Least Costly Alternate
1	Genesee River below Eastman Kodak	$1,080,000 (2)	$557,000	$500,000	Effluent transport
2	Genesee River below Gates-Ogden-Chili STP	134,000± (2)	101,000	NA	Single purpose reservoir
3	Genesee River below Avon	(4)	55,000	NA	Single purpose reservoir
4.	Oatka Creek below Warsaw	10,400 (3)	37,500	NA	Single purpose reservoir
5	Honeoye Creek below Honeoye Falls	23,160± (3)	19,800	NA	AWT
6	Wilkins Creek below Livonia	5,300 (3)	10,000	10,000	Single purpose reservoir
7	Mill Creek below Wayland	9,220	13,500	NA	Single purpose reservoir

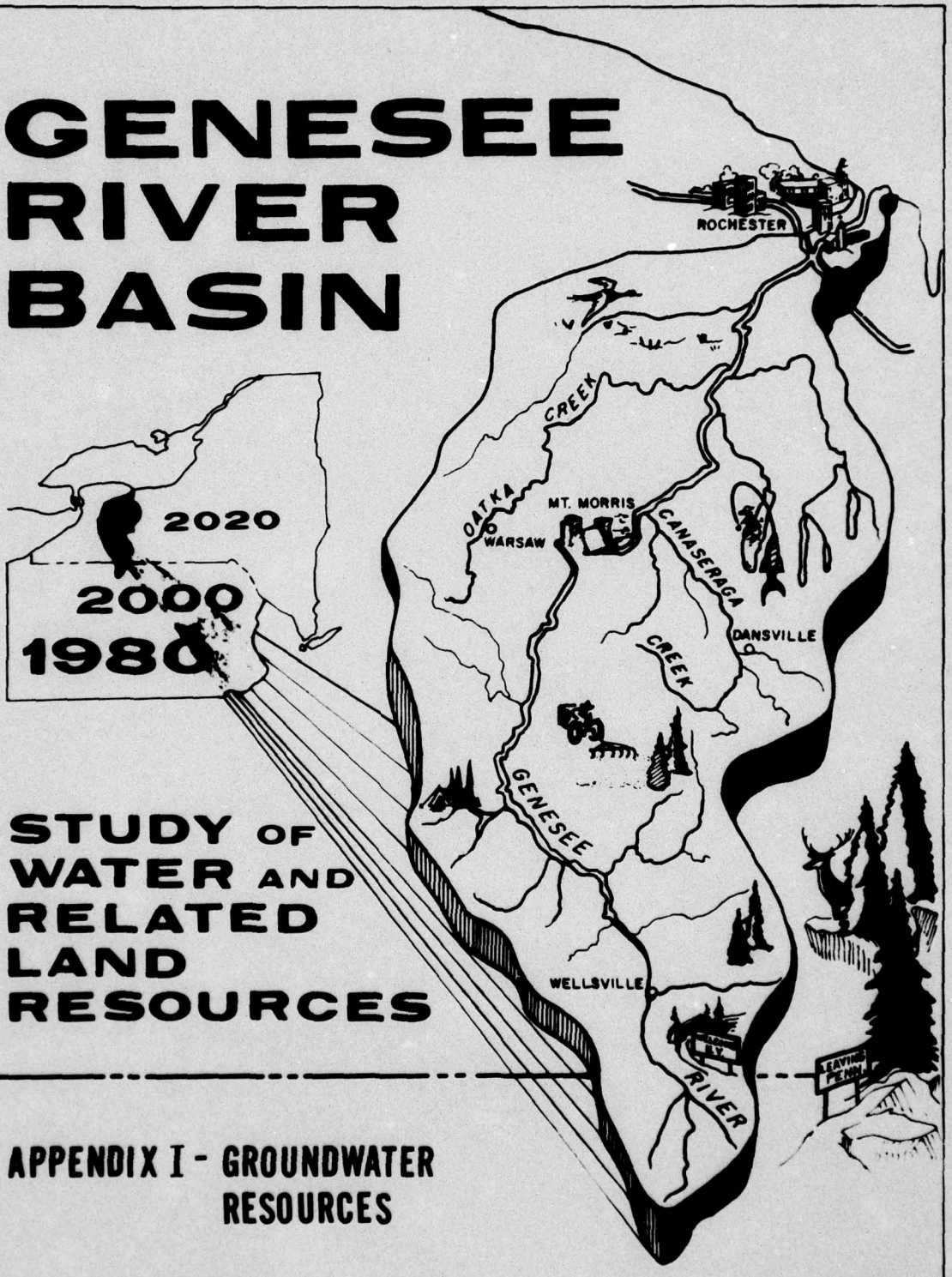
(1) Based on interest rate of 3 1/8 percent for cost of money and discounting future expenditures to present worth.

(2) Costs furnished by U. S. Corps of Engineers.

(3) Costs furnished by U. S. Soil Conservation Service.

(4) Reservoir for Gates-Ogden-Chili satisfies need. No additional cost is involved.

GENESEE RIVER BASIN



STUDY OF WATER AND RELATED LAND RESOURCES

APPENDIX I - GROUNDWATER RESOURCES

APPENDIX I (Ground-Water Resources)

of the

GENESEE RIVER BASIN COMPREHENSIVE STUDY

THE GEOLOGY AND AVAILABILITY OF GROUND WATER IN THE GENESEE RIVER BASIN, NEW YORK AND PENNSYLVANIA

by

J. C. Kammerer and W. A. Hobba, Jr.

Prepared by

UNITED STATES DEPARTMENT OF THE INTERIOR

GEOLOGICAL SURVEY

in cooperation with the

NEW YORK STATE CONSERVATION DEPARTMENT

DIVISION OF WATER RESOURCES

for

U.S. Army Engineer District, Buffalo

Corps of Engineers

Buffalo, New York 14207

1967

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THE GEOLOGY AND AVAILABILITY OF GROUND WATER IN THE GENESEE RIVER BASIN, NEW YORK AND PENNSYLVANIA

By

J. C. Kammerer and W. A. Hobba, Jr.

ABSTRACT

During 1964 and 1965, a ground-water study was made of the 2,500-square mile Genesee River basin, located mainly in western New York, and extending northward from Pennsylvania to Lake Ontario. This report on the study summarizes and interprets data on quantity and quality of ground water, including a bedrock map and a surficial geologic map of the basin. Appendix tables contain drillers' logs and chemical and sanitary analyses of water.

Of the total ground-water use of about 12 mgd (million gallons per day), 8 mgd are from sand and gravel deposits of glacial origin, located mainly in valleys and lowland areas. Probably several times this much ground water could be safely developed, some of it by stream infiltration near the mouths of the major tributaries of the Genesee River. Yields from individual wells used for public or industrial supplies generally range from 20 to 700 gpm (gallons per minute).

Bedrock is shale, limestone, dolomite, and sandstone, which dips to the south at 40 to 60 feet per mile. Yields from wells in bedrock are generally between 2 and 190 gpm, and often less than 10 gpm. The higher yields are from wells in limestone or dolomite, or from wells that may also draw some water from unconsolidated materials lying on top of the bedrock.

The best (least mineralized) water -- 80 to 400 ppm (parts per million) of dissolved solids -- is obtained from glacial deposits overlying the upper shale-sandstone unit in the central and southern parts of the basin. The most highly mineralized water -- 500 to 2,000 ppm of dissolved solids -- is from the gypsum-shale unit (mainly Camillus Shale of Late Silurian age). Most ground water is safe to drink without treatment. However, disinfection is recommended as minimum treatment for all municipal water supplies to guard against and overcome unusual or unexpected contamination, regardless of the apparent purity of the source.

INTRODUCTION

Purpose of Investigation and Report

The purpose of the investigation of the ground-water resources of the Genesee River basin is to determine the location, magnitude, and quality of available ground-water supplies. The investigation includes a study of the geologic environment in which ground water occurs. The results of the investigation through 1965 are presented in this report; a final report will incorporate the ground-water data and interpretation contained in this report in a comprehensive description of both the ground-water and surface-water resources. The ground-water investigation in the basin is being financed jointly by the U.S. Geological Survey and the New York State Conservation Department, Division of Water Resources.

The U.S. Army Corps of Engineers is the coordinating agency of the Federal-State "Genesee River Basin Comprehensive Water-Resources Study," of which the ground-water investigation has been a part. This report fulfills the requirements of Task Group 4 (Ground-Water and Quality of Water Studies) with respect to quantity and quality of ground water under the task group leadership of the New York State Department of Health.

Content and Format of Report

The objective, with respect to report format, is to orient the reader quickly as to the interrelated geographic, geologic, and hydrologic environments, as well as to give the principal conclusions resulting from the collected data. Therefore, the text has been kept reasonably brief, and much information is presented in the form of maps and tabular summaries of data. At the end of the report is a list of the principal publications consulted during the preparation of this report followed by a series of five tables (in the appendix) containing most of the basic data upon which the report is based.

Two maps of the basin (plates 1 and 2) show the surficial and bedrock geology along with an explanation of their significance with respect to occurrence, availability, and quality of ground water in the region.

Each well, test hole, and spring is identified by a 7- or 8-digit number locating the site within a "1-minute area" of latitude and longitude. For example, well 206-756-9 is the 9th well recorded within a 1-minute area bounded at its southeast corner by north latitude 42° 06'00" and by west longitude 77° 56'00". Note that the first "4" of latitude and the first "7" of longitude are always omitted from the number. All wells and test holes referred to in the report and in the appendix are briefly described in table A-1 of the appendix (by counties) and their locations are shown in plate 1.

Reference to sources of information are given in parentheses, and include the name of the principal author and the date of publication, such as "(Broughton and others, 1962)." The full title will be found in the selected list of publications just preceding the appendix.

Previous Investigations

Ground-water studies in the Genesee River basin have been limited to Monroe County (Leggette and others, 1935; field work in 1934 and 1935), and Ontario County (Mack and Digman, 1962; field work 1947-49, 1954).

Many geologic studies have been made of various parts of the basin, especially by the late H. L. Fairchild, professor of geology for many years at the University of Rochester. The three most useful sources of geologic or geologic-related information used in preparation of this report are the State geologic bedrock map of 1961 (Broughton and others, 1962), scale 1:250,000; the series of soil surveys published by the U.S. Department of Agriculture (Lewis and others, 1927; Pearson and others, 1934, 1938, 1940, 1956, 1958), scales 1:62,500 or 1:24,000; and the report, Geologic story of the Genesee Valley and western New York (Fairchild, 1928).

Some of the many other geologic studies are included in the list of publications given at the end of this report as well as a reference to the map index of geologic reports of New York (Boardman, 1952), listing all such reports published to 1950.

In 1953, the Geological Survey published a summary report on the water resources of the Rochester area (Grossman and Yarger, 1953). This report and the ground-water report on Monroe County are now out of print, as are many of the geologic reports including Prof. Fairchild's book of 1928.

Scope and Methods of This Investigation

The investigation to date (1964-65) has consisted mainly of an inventory of wells, chemical analysis of water from selected wells, and a concurrent effort to determine the regional geologic and hydrologic relationships pertaining to ground water in the Genesee River basin. The State geologic map of 1961 was used as the principal source of information on bedrock geology and the geologic contacts shown in plate 1 were copied from that map. Plate 2, the map of surficial deposits, was prepared from published soil maps and field data.

More than 500 well or test-hole sites were visited, and data were obtained at most of them on the construction of the well and other ground-water data, such as measured or reported depth to water, reported

yield, and amount of water used. Those 260 wells and test holes for which the most useful and complete data were available, including all those from which water samples were collected for analysis, are listed in table A-1 of the appendix and shown in plate 1. Data for an additional 63 wells from the Monroe County report of 1935 (Leggette and others) are also included in table A-1 because chemical-quality information already available for ground water at these well sites was a part of the basic data evaluated during the present study.

Drillers' logs of 145 wells or test holes are listed in table A-2. Nearly 200 chemical analyses made by the U.S. Geological Survey of water from wells and springs are given in table A-3, and 67 sanitary analyses of ground water made by the New York State Department of Health are in table A-4. About 100 chemical analyses made by the Geological Survey of water in streams during periods of low streamflow in 1964 and 1965 are contained in table A-5. These analyses indicate the chemical quality of shallow ground water at and upstream from the sampling site.

Important Characteristics of Ground Water as a Resource

Ground water is the source of water for more than half of the municipal water supplies as well as for most of the privately owned supplies for farms and homes in rural areas. Some industries also depend upon ground water as a source of supply. Ground water is particularly important in the southern two-thirds of the basin because this area is farther removed from the large metropolitan water systems using Lake Ontario as the principal source of supply. However, ground water is also important in the northern one-third as a source for industrial supplies of moderate size, and for public uses in an emergency.

Ground water as a source of supply may be more economical or dependable than surface water, especially for small- or moderate-size supplies because of the following characteristics:

1. Ground-water supplies, particularly small ones, can be obtained from wells drilled near the point of use, and, therefore, most transmission lines for ground-water supplies can be short in contrast with lines for surface-water supplies.

2. In most drilled wells the temperature and chemical quality of the water at any one place are nearly constant throughout the year, the water temperature usually being at or near the mean annual air temperature. Rarely is ground water turbid to a significant extent.

3. Ground water is not so frequently nor easily contaminated as surface water because of its location relatively "out of reach" of atmospheric or land-surface pollutants; this is especially true of properly constructed drilled wells which penetrate an impermeable layer, such as clay, before reaching the water-bearing formation.

Acknowledgments

The cooperation and assistance of many well owners and well drillers are gratefully acknowledged, including personnel at many industrial plants. Particular thanks are due to the many superintendents of municipal water supplies; also to Prof. E. H. Muller of Syracuse University; to Robert Charles of the Layne-New York Co., Rochester; to W. H. Young, Jr., of Bradley Producing Corp., Wellsville; and to V. H. Lockwood of the Air Preheater Co., Wellsville.

This investigation has been conducted under the supervision of R. C. Heath, District Chief, and B. K. Gilbert, Project Chief. Additional direction and cooperation have been received from Dewayne Day, Regional Engineer, and his staff, New York State Department of Health, Rochester.

THE ENVIRONMENT OF GROUND WATER IN THE BASIN

Physical Setting

The Genesee River flows northward from its headwaters in north-central Pennsylvania, across the 90 miles of western New York and into Lake Ontario. More than 95 percent of the 2,500-square mile river basin is in New York State, mainly in parts of Allegany, Genesee, Livingston, Monroe, Ontario, and Wyoming Counties. Altitudes in the southern two-thirds of the basin, a part of the Appalachian Uplands, are generally between 1,000 and 2,200 feet. The altitude of Lake Ontario is 246 feet. Figure 1 shows some of these physiographic relationships, including the 500-, 1,000-, and 2,000-foot contour lines.

The Uplands part of the basin is predominantly rural, and many farms (mainly dairy and vegetable farms) cover the gently to moderately sloping hillsides and fertile valleys. Farming also predominates in much of the northern Lowlands region except near the cities of Rochester and Batavia, the only places with populations greater than 7,000 people. Present industrialization is widely dispersed except in Monroe County (Rochester Metropolitan area) and near Batavia.

The average annual precipitation ranges from 30 inches in the northern part of the area to 38 inches in the southern part. Annual runoff averages between 33 and 53 percent of the average annual precipitation. Figure 2 shows the average annual precipitation and runoff of the Genesee River basin in relation to the remainder of New York State.

There are few large streams in the river basin other than the Genesee River itself. None of the tributaries has a drainage area greater than 400 square miles, and only Canaseraga, Honeoye, and Oatka Creeks, all in the central and northern parts of the basin, have drainage areas greater than 200 square miles. Therefore, the flows of most of the tributaries are relatively small (each less than 10 million gallons per day) during a part of the summer or autumn. Six lakes in the river basin (including the four smallest of the Finger Lakes) have surface areas between about 1 and 5 square miles. Other lakes and ponds are much smaller. The principal mineral resources are petroleum, natural gas, salt, limestone, gypsum, and sand and gravel.

Geologic Setting

Structure and Brief History

The geologic structure of the Genesee River basin is simply stated: The base or "foundation" is bedrock (mainly of Devonian and Silurian age) some thousands of feet in thickness and which is composed of layers of shale, limestone, dolomite, and sandstone. These layers dip gently to the south at an average of between 40 and 60 feet per mile.

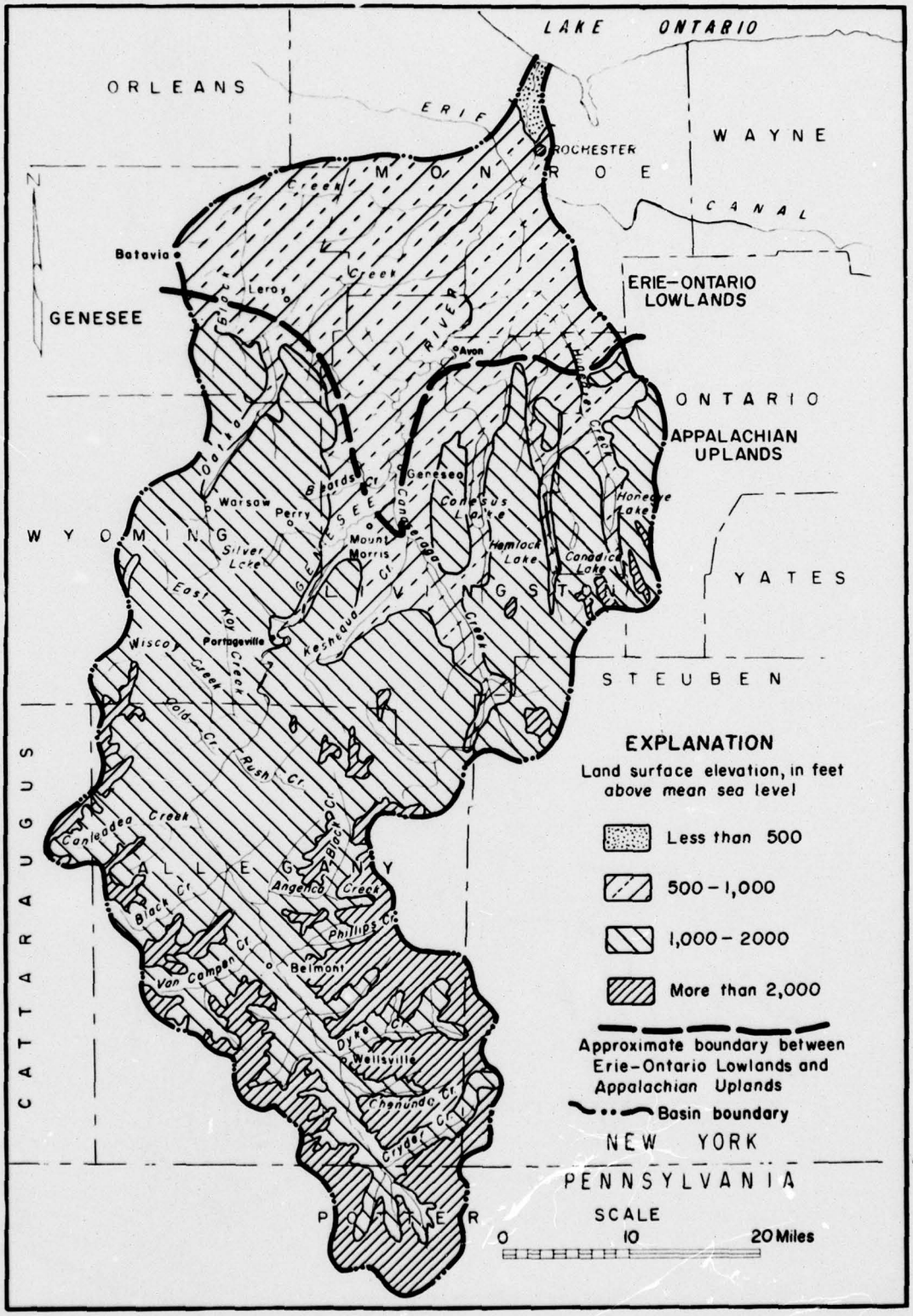
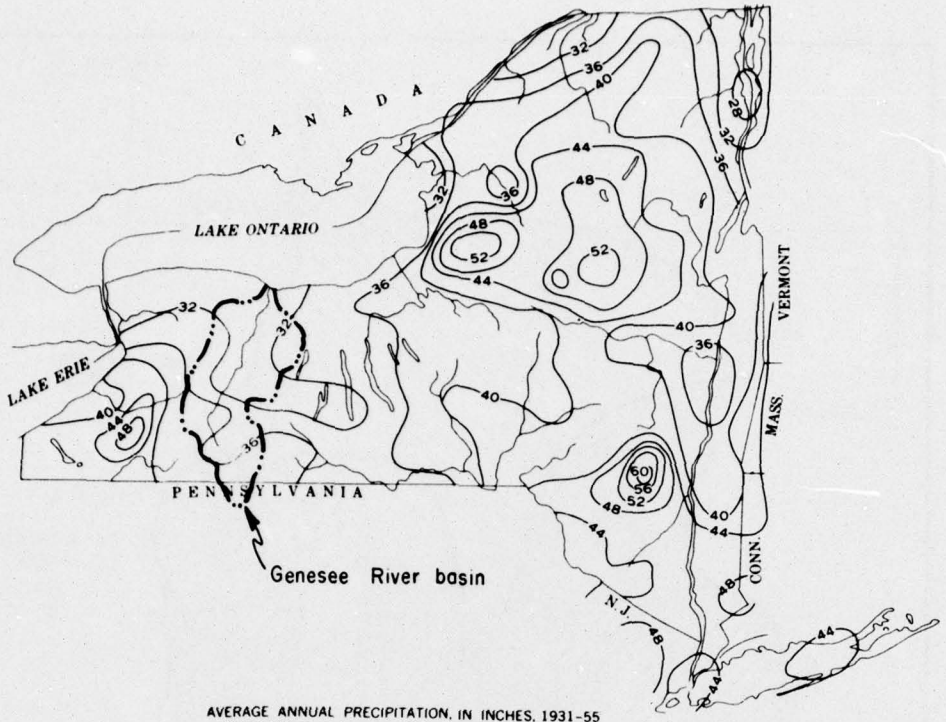
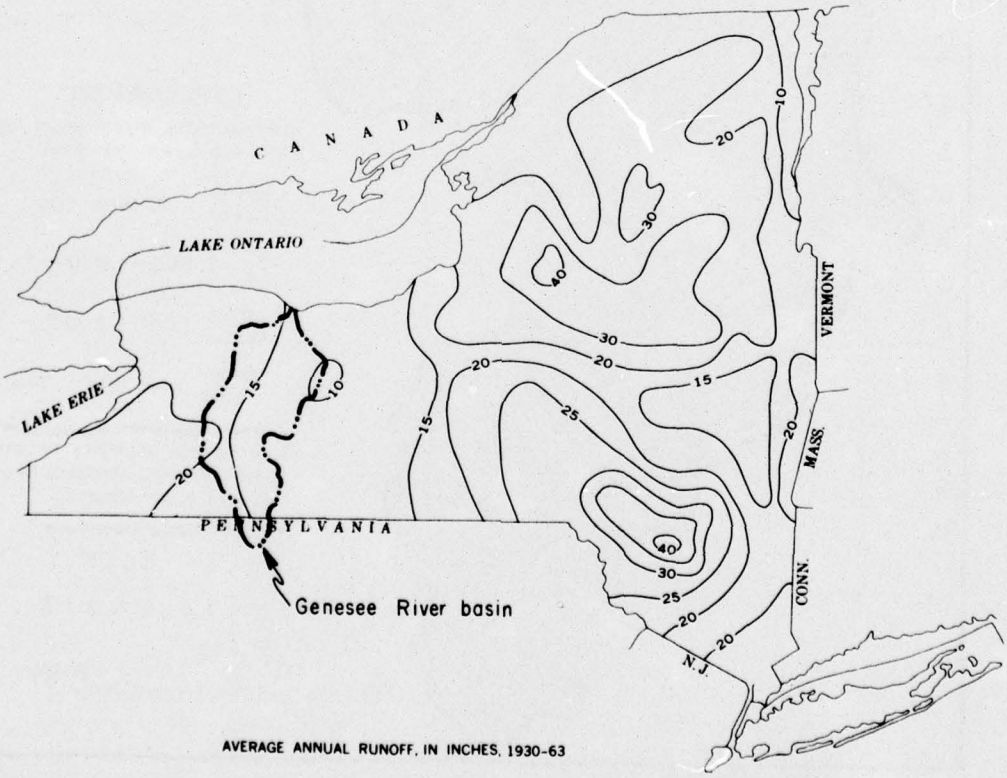


Figure 1. Principal physical features.



AVERAGE ANNUAL PRECIPITATION, IN INCHES, 1931-55
(Adapted from maps prepared by U.S. Weather Bureau)



AVERAGE ANNUAL RUNOFF, IN INCHES, 1930-63

Figure 2. Average annual precipitation and runoff in the Genesee River basin in relation to the other parts of the State.

Successions of layers are classified geologically as a "group" of formations, a "formation," or a "member" of a formation. On top of the bedrock are glacial (Pleistocene) deposits of clay, sand, and gravel. These deposits are thin on the uplands, generally less than 50 feet in thickness, and at some places less than 10 feet. On the other hand, in the valleys of the Genesee River and its principal tributaries, the glacial deposits are commonly between 100 and 300 feet in thickness; maximum recorded thickness is about 600 feet. The principal exceptions to such thicknesses in the valleys are the Genesee River gorges between Portageville and Mount Morris and at Rochester where bedrock is at or close to the land surface.

Each layer of bedrock was deposited as clay, lime, or sand on the bottom of the sea which covered the entire Genesee region several hundred million years ago. With deep burial these sediments were compacted and cemented into shale, limestone, and sandstone. About 200 to 300 million years ago, the region rose above the sea. Since that time the uplifted land has been almost constantly subjected to erosion except for periods of resubmergence.

Just prior to glaciation, some of the major topographic features of the Genesee River basin resembled their present forms, but with several important differences. The hilltops were steeper and rockier, and bare rock was probably visible in many more places than it is now. Also, Fairchild (1928, p. 108) and others have suggested that the Genesee River system was much larger than it is today, and included a major east branch which flowed in what is now the wide valley of Canaseraga Creek.

The landscape was again subjected to major changes during Pleistocene times. Most of the unconsolidated deposits were formed when a continental glacier spread southward from Canada as a result of climatic conditions that caused ice and snow to accumulate each year at a faster rate than they were melting. The massive ice sheet, hundreds of feet in thickness, ground its way into and over most of New York State. Hilltops were rounded, some valleys were widened or deepened, and the glacier by its crushing and abrasive action on the land surface, produced tremendous quantities of rock debris, much of it the dense clay-sand-gravel mixture known as "till." Finally the climate became warmer, melting began to predominate over freezing, and the glacier began its slow retreat northward, interrupted occasionally by substantial periods of time when the ice front was relatively stationary.

When the glacier first began its southward advance, the outlets of north-flowing streams such as the Genesee were blocked, and temporary lakes formed in front of the glacier while the streams were forced to find new outlets to the east, west, and south. Erosion was the predominant geologic process. Then, as the glacier retreated, several kinds of clay, sand, and gravel deposits were formed. These include a mantle of till on most of the uplands, outwash deposits of sand and gravel in glacier-fed streams, extensive clay deposits in glacier-blocked

lakes, and layers of till, clay, sand, and gravel in various proportions in places where the glacier halted for a long period of time (moraine deposits). Many of the deeper valleys were filled with rock debris from the melting glacier, sometimes as till and at other times as sorted deposits of clay or sand and gravel. This valley filling was so extensive in some cases that a former stream course was blocked entirely. Thus, much of the former "East Branch" of the Genesee River was permanently blocked off, and the main river carved a new course northward at Portageville and Avon resulting in the present gorges of the Genesee River through Letchworth Park and at Rochester.

One of the most extensive types of deposits resulting from glacial action in the Genesee River basin is fine-grained sediment, mostly clay and silt, which is thick and extensive, especially in the central part of the basin. These sediments were deposited in a series of glacial lakes that extended completely across the present valley of the Genesee River. As the glacier retreated northward, successively lower melt-water outlets across the divides of the valley were uncovered and lakes were formed at successively lower altitudes. After the lakes were drained, many of the lake deposits were removed by erosion, especially in the central parts of the valleys.

The most permeable deposits of glacial origin are sand and gravel. As the ice sheet receded, the melt-water streams which issued from the glacier deposited large quantities of sand and gravel, especially at the foot of the glacier in the glacier-blocked lakes and in fans and floodplains on top of the drained lake deposits of finer grained materials. Some upland streams deposited sand and gravel at the edges of glacial lakes. These deposits interfinger with finer grained, lake-laid deposits of silt and clay.

The preceding discussion of glacial history, even though brief and greatly simplified, indicates the great extent and sometimes complex nature of the glacial deposits in the Genesee River basin.

Geologic-Hydrologic Units

As one of the results of the many geologic studies carried out intermittently during the past century in the Genesee River basin, at least 50 geologic formations have been named and described as to composition, thickness, age, and location of surface or subsurface occurrence. The principal formational names are listed in chronological order (youngest to oldest, top to bottom) in table 1, based primarily on the State geologic map of 1961 (Broughton and others, 1962). Although most of these formation names will not be referred to again in this report except in plate 1 and figure 4, the list in table 1 should be helpful to anyone attempting to orient himself geologically and to correlate the older, more detailed geologic maps and reports with the occurrence of ground water as described in this report.

Table 1.--Age, thickness, and principal rock types of bedrock formations, in order from youngest to oldest

NOTE: The geologic names listed below are adapted mainly from the State geologic map of 1961 (Broughton and others, 1962), and are not necessarily the standard names or units in presently accepted usage by the U.S. Geological Survey. Some partly or wholly equivalent formations (time-wise) interfinger with each other, such as the Wiscoy Sandstone with the Hanover Shale.

Water-bearing unit	Geologic system and series	Name of group (Map symbol on State geologic map of 1961)	Name of formation	Principal rock types	Examples of thickness or range in thickness (feet)	Principal economic uses in the basin 1/
Upper shale-sandstone unit	Upper Devonian	Conewango (Dco)	Oswayo Formation	Shale, sandstone	150	
			Cattaraugus Formation	Shale, sandstone, conglomerate	370	
		Conneaut (Dct)	Germania Formation	Shale, sandstone	70	
			Whitesville Formation	Shale, sandstone	300	
			Hinsdale Sandstone	Sandstone	15	
			Wellsville Formation	Shale, sandstone	200	Ground water
			Cuba Sandstone	Sandstone, siltstone	40	Petroleum (from thin oil-bearing sandstones, including the Richburg and Bradford sands)
		Canadaway (Dcy)	Machias Formation	Shale, siltstone	400	
			Rushford Sandstone	Sandstone, shale	600	
		Perrysburg Formation	Caneadea Formation	Shale, siltstone		
			Hume Shale	Shale	0-70	
			Canaseraga Sandstone	Sandstone, Siltstone	160-300	
			South Wales Formation	Shale	20-80	
			Dunkirk Shale	Shale	5-15	
		Java (part of Djw)	Wiscoy Sandstone	Sandstone, siltstone	150-200	
			Hanover and Pipe Creek Shales	Shale, siltstone		
		West Falls (part of Djw)	Nunda ("Portage") Sandstone	Sandstone, shale	180-215	Building stone ("bluestone")
			West Hill Formation	Shale, siltstone	35-	
		"Naples" Group	Gardeau Shale	Shale	300-500	
			Grimes Siltstone	Siltstone	0-50	
			Hatch Shale	Shale	100-200	
			Rhinestreet Shale	Shale	30-100	
		Sonyea (Ds)	Cashaqua Shale	Shale	100-200	
			Middlesex Shale	Shale	10-40	
		Genesee (Dg)	West River Shale	Shale	30-75	
			Genundewa Limestone	Limestone	5-10	
			Penn Yan Shale	Shale		
			Geneseo ("Genesee") Shale	Shale	30-90	
			Leicester Marcasite	Pyrite, marcasite	0-1	
			Tully Limestone	Limestone	0-	
	Middle Devonian	Hamilton (Dhu)	Moscow Shale	Shale, thin limestone	70-145	
			Ludlowville Shale	Shale, thin limestone	115-190	
			Skaneateles Shale	Shale, thin limestone	190-235	
		(Dhl)	Marcellus Shale	Shale, thin limestone	30-40	Natural gas
Limestone-dolomite unit		(Don)	Onondaga Limestone	Limestone	130-150	Aggregate; natural gas; ground water
	Lower Devonian		Bois Blanc Formation	Limestone	0-4	
			Oriskany Sandstone	Sandstone	0-5	Natural gas
	Upper Silurian	(Sb)	Akron or Cobleskill Dolomite	Dolomite	5-25	
			Bertie Limestone	Dolomitic shale, limestone	45-85	
Gypsum-shale unit		Salina (Ss)	Camillus Shale	Gypsum-bearing shale, dolomite, salt	250-300	Salt; gypsum
			Syracuse Salt or Formation			
			Vernon Shale (including "Pittsford Shale" at base)	Shale	200-300	
Dolomite unit		(Sl)	Lockport Dolomite	Dolomite, dolomitic limestone	150-300	Aggregate; ground water
Lower shale-sandstone unit	Middle Silurian	Clinton (Sr)	DeCew Dolomite	Dolomite	10-15	
			Rochester Shale	Shale	85	
			Irondequoit Limestone	Limestone, shale	18	
			Williamson Shale	Shale	6	
			Wolcott Limestone	Limestone	0-	
		(Sk)	Sodus Shale	Shale, limestone	11-18	
			Reynales Limestone	Limestone	18	
			Maplewood Shale	Shale	21	
			Kodak or Thorold Sandstone	Sandstone	3	
	Lower Silurian	Albion Group (or upper part of Medina Group of former usage) (Sm)	Grimsby Sandstone	Sandstone, shale	40-55	Natural gas
			Whirlpool Sandstone	Sandstone	0-	
	Upper Ordovician	(Oq)	Queenston Shale	Shale, siltstone	1,000	

1/ Most of the 56 formations will yield at least a few gallons per minute of ground water to individual wells in some parts of the basin. However, the words "ground water" are shown opposite only those formations from which yields greater than 50 gallons per minute have reportedly been obtained from some wells.

The following geologic names are not listed in the table above because they are at least partly equivalent to formations which are listed by other names in the table: Gowanda Formation and Canisteo Shale - each approximately or partly equivalent westward and eastward, respectively, to the combined Caneadea Formation and Hume Shale; Angola Shale - approximate equivalent westward of the combined Nunda Sandstone and Gardeau Shale; Rockstream Siltstone and Pulteney Shale - approximate equivalent eastward of the Cashaqua Shale.

The following "group" names are no longer in use, although they appear in many of the older geologic reports: Chemung, Portage, Niagara. The Chemung Group was usually applied to all the Upper Devonian beds underlying the Cattaraugus Formation and overlying the Wiscoy Sandstone. The Portage Group of beds immediately underlies the Chemung Group and extends downward to and including the Middlesex Shale. The Niagara Group has been applied mainly to the Lockport Dolomite and the Rochester Shale.

With respect to ground water, the bedrock formations may be combined to form five principal "water-bearing units," as shown in the last column of table 1. Each of these water units has some fairly distinct characteristics as to the quantity or quality of water it contains. The map locations of the outcrop areas of these same five units are shown in figure 3, and in greater detail in plate 1. These same units are also identified in figure 4, a north-south geologic section of the Genesee valley adapted from Fairchild (1928, p. 29). Note that there is extreme vertical exaggeration in figure 4, the vertical scale being about 130 times the horizontal scale. If the scales were the same, the land-surface profile would look practically flat.

Each of the five names of these water-bearing bedrock units contains the two or three words which seem to describe best the principal kind of rock or mineral contained in the unit. The choice of names is arbitrary and is not intended to apply to areas outside the Genesee River basin. The five water-bearing units are, in order of increasing age:

Upper shale-sandstone unit
Limestone-dolomite unit
Gypsum-shale unit
Dolomite unit
Lower shale-sandstone unit

Note in figure 3 that the upper shale-sandstone unit covers about three-quarters of the basin. The other bedrock water-bearing units occur beneath the upper shale-sandstone unit as they dip southward in successive layers. However, these water-bearing units are deeply buried beneath the upper shale-sandstone unit (fig. 4) as the land rises to the south and, therefore, are not tapped by water wells except in the northern one-quarter of the basin where the units are at or close to the land surface.

The youngest water-bearing units, which overlie the bedrock, are unconsolidated deposits mainly of glacial origin. These are as follows:

Sand and gravel
Clay or silt or muck
Till

The distribution of these units is shown in plate 2. In most places water must pass through the unconsolidated deposits before it can reach bedrock. A thin mantle of till lies directly on top of bedrock in most upland areas. Other surficial deposits of glacial origin -- stratified sand and gravel, clay, silt -- are found mainly in valley and lowland areas, as well as on the hillsides of some of the larger valleys. Thin alluvial deposits of clay, sand, and gravel were laid down by streams in recent time and overlie the stratified glacial deposits in many valleys. The unconsolidated deposits are discussed further in this report under, "Availability of Ground Water from Unconsolidated Deposits."

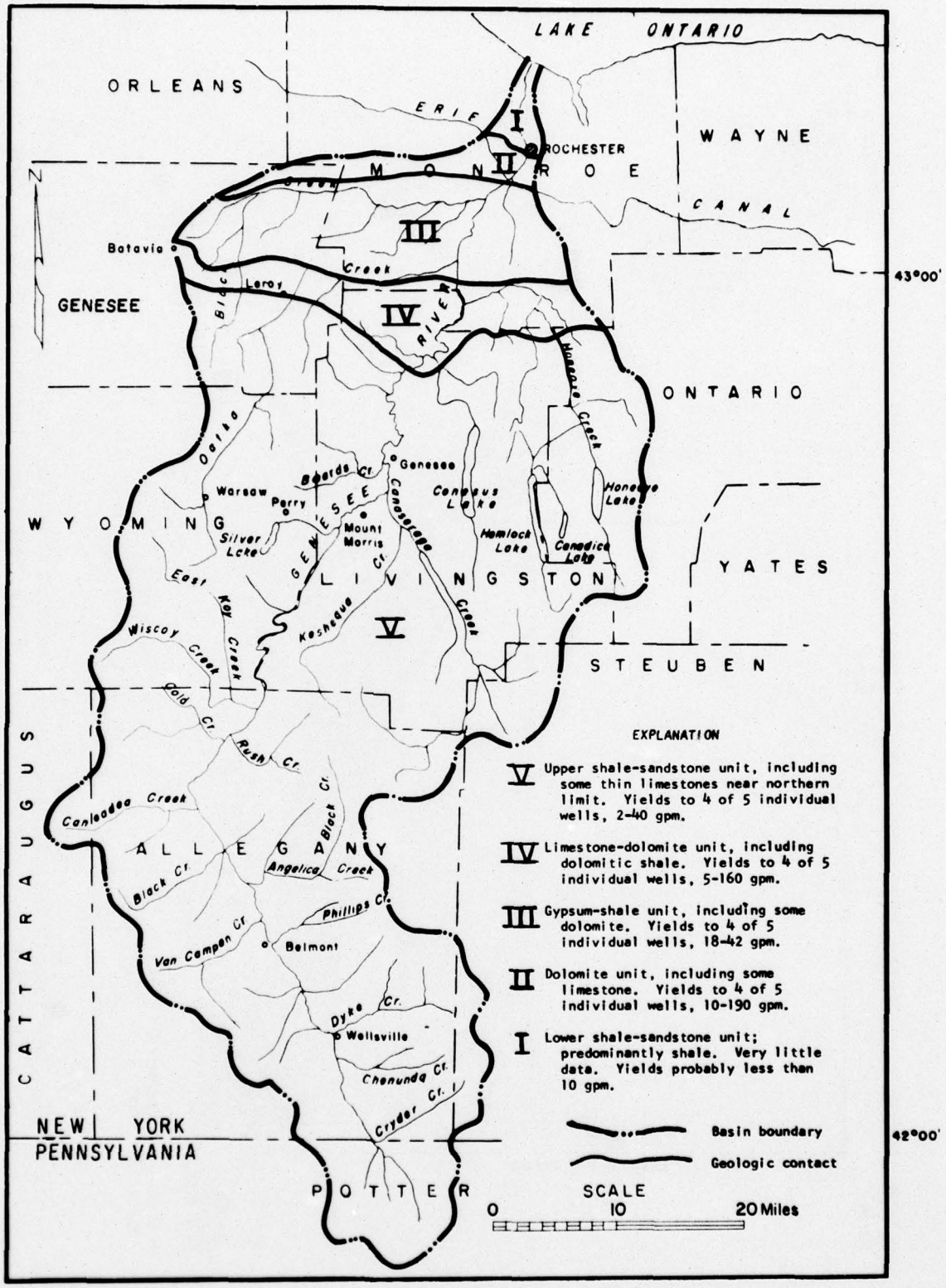


Figure 3. Location of the water-bearing bedrock units described in this report.

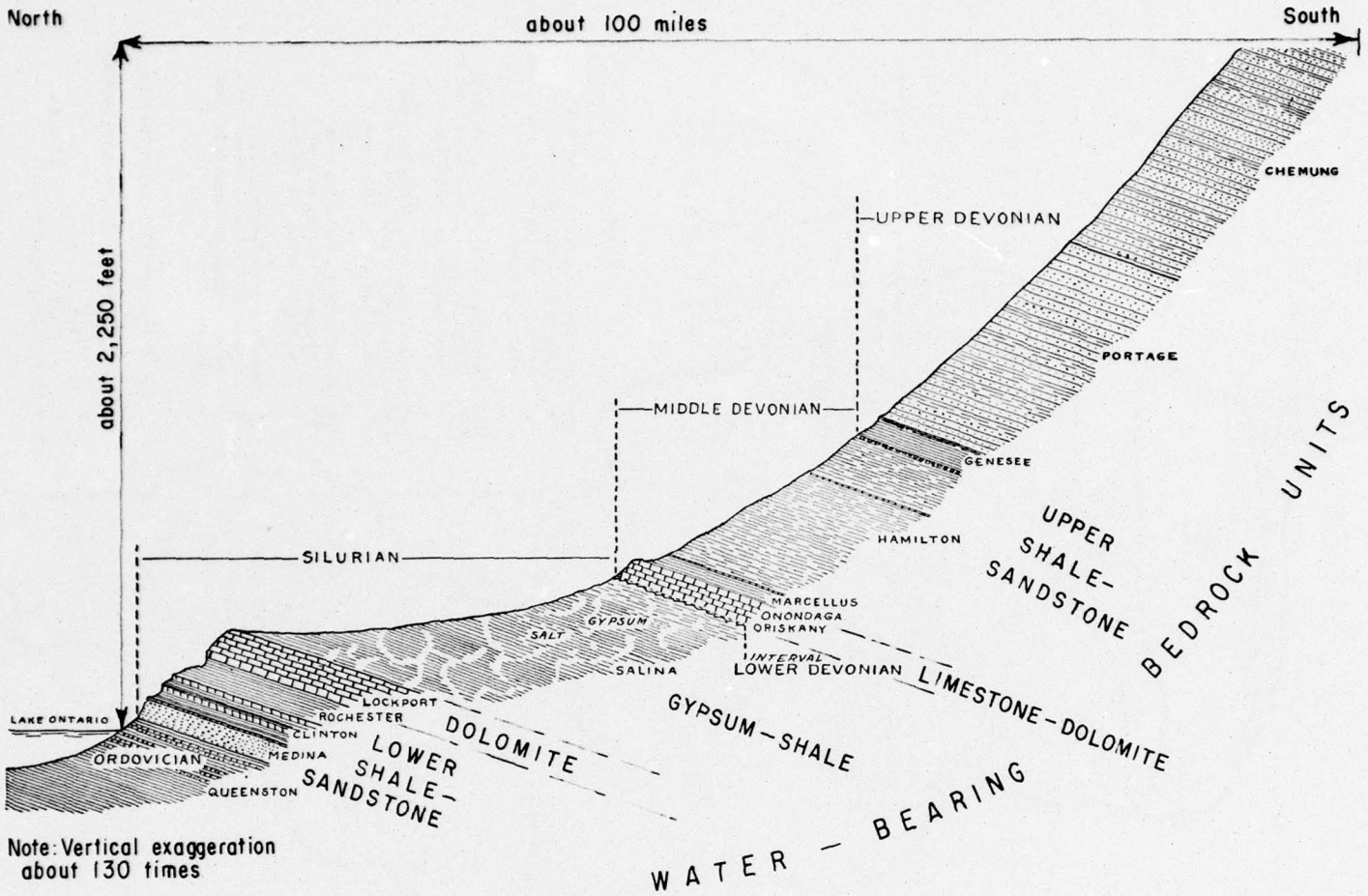


Figure 4. North-south geologic section of the rock strata of the Genesee valley, from Lake Ontario to the Pennsylvania State line (from Fairchild, 1928, p. 29).

Relationship of Ground Water to Streams

Water as it occurs underground in the form we commonly call "ground water" is but one part of a never-ending water cycle where water is precipitated from the atmosphere as rain or snow, flows over and through the ground toward streams and seas, and is evaporated and transpired back to the atmosphere. It is a dynamic cycle of constant motion, and although the proportions of water in the atmosphere, in the streams, and under the ground are continually varying with respect to one another, the world-wide total of water in motion remains essentially the same. However, because of seasonal and regional variations in climate, the water available for use at any one place and time varies widely between the extremes of "too much" and "too little," although the extremes are not nearly so severe in the Genesee River basin as in some other parts of the nation.

Ground water is one of nature's tools which helps to lessen the extremes of water availability. If all of the land were impervious and, therefore, no water could enter the ground, the entire region would be almost dry within a few days after each rainfall, and we would be in a nearly constant state of either flood or famine. Instead, however, a significant part of the rainfall enters the ground. Part of this water replenishes the soil moisture which is used by grass, trees, and crops, and part continues downward to the water table, the top of the zone of saturation. From the water table, ground water moves downward and laterally, and usually finds its way to a spring, stream, or lake from where the water flows to the sea. Ground water is entering streams nearly all the time and is the sole source of streamflow during extended periods of dry weather.

The rate of ground-water discharge to a stream is dependent upon the ability of the water-bearing deposits to store and transmit ground water. Thus, a stream draining thick and permeable water-bearing deposits will have a larger dry-weather flow than one draining deposits of low permeability. Two small streams near the center of the Genesee River basin illustrate this point. White Creek and Little Conesus Creek drain small areas west and east, respectively, of the Genesee River near Avon, Livingston County. Many of the unconsolidated deposits of White Creek basin are highly permeable sand and gravel in contrast to the low permeability of clay and till covering most of the basin of Little Conesus Creek. The basin of Little Conesus Creek is about four times the size of that of White Creek. However, on October 1, 1964, after an abnormally dry September, the flow of White Creek was about 50 times that of Little Conesus Creek. There is not this much contrast between most basins, especially the larger ones, because the basins contain a combination of both highly and poorly permeable deposits. The more permeable deposits usually occur along with thick fine-grained deposits of low permeability in valleys. Most upland deposits have low permeability.

There is, of course, also a close relationship between the chemical quality of ground water and that of the water in streams, particularly at low streamflows which are entirely or almost entirely supplied by ground water. Thus, the chemical quality of water in shallow wells is essentially the same as that found in adjacent small streams during low flows. It is because of this close quality relationship between ground water and streams that many of the streams were sampled for chemical analysis by the Geological Survey during September and October 1964, in order to obtain a regional knowledge of the chemical quality of shallow ground water. All the sampling sites are shown in plate 1, and the chemical analyses are presented in appendix table A-5 at the end of this report. These data were used along with analyses of ground water from wells and springs to show the regional zones of water quality in plate 1.

The final and very important point to be made regarding the close interrelationship which exists between ground water and streams, both with respect to quantity and quality, is that major manmade uses or mis-uses of ground water may also affect the water in streams. For example, a withdrawal of 1 mgd from a group of shallow wells in permeable deposits adjacent to a small stream with a late-summer flow of 4 mgd will undoubtedly reduce the streamflow (downstream) a significant amount unless the ground water, after use, is returned to the stream.

BASIN-WIDE SUMMARY OF THE GROUND-WATER RESOURCES

The ground-water resources of the Genesee River basin are probably most concisely described by the adjectives "moderate" or "modest" (in total quantity), and "diverse" (in quantity and quality from place to place). They are neither so large as to be an adequate sole source of water supply for large cities and major water-using industries, nor are the ground-water supplies so small that it is prudent and economical to ignore their existence. Their principal usefulness is for a village, farm, or commercial or industrial establishment with small or moderate water needs, and as a supplementary or emergency water supply for larger water users.

The ground-water situation for the entire river basin is summarized in table 2 and in plates 1 and 2. The table and the two plates describe ground water by water-bearing units, as described in a preceding section, "Geologic-Hydrologic Units." Plate 1 is a map of the water-bearing bedrock units, well and stream sites, and water-quality zones. Plate 2 is a map of surficial geologic units mainly of glacial origin. The thickness of these deposits (depth to bedrock) at more than 100 well sites is included with other well data in appendix table A-1.

Quantity of Ground Water

Present basin-wide, ground-water use averages about 12 mgd (million gallons per day). Full economic development of ground water in the basin would be at least several times this present rate of use.

Sand and gravel deposits in stream valleys are the principal sources of ground water in the basin for present and future development. Such deposits are found in the areas identified in plate 2 as "coarse-grained stratified deposits," and they occur in valleys and lowlands. In the main valley of the Genesee River itself (except in the bedrock gorges at Rochester, and between Portageville and Mount Morris), and in many of its principal tributaries, the sand and gravel deposits are usually between 5 and 30 feet in thickness, especially in the central and southern parts of the basin. South of Portageville, the sand and gravel deposits along the Genesee are usually beneath more than 100 feet of finer grained materials such as clay and silt, while in the remainder of the basin sand and gravel is found at shallower depths. The principal areas where substantial quantities of ground water may be obtained at shallow depths are (1) the Wayland-Perkinsville areas in Steuben County, (2) the East Koy-Gainesville-Lamont area in Wyoming County, (3) the Canawaugus-Caledonia area in Livingston County, and (4) an area east of Canaseraga in Allegany County.

Yields of 100 to 700 gpm (gallons per minute) are obtainable from individual, properly constructed wells tapping sand and gravel aquifers in the Genesee River basin. The amount of ground water available for development from these aquifers is dependent upon the recharge to these

Table 2.--Summary of the ground-water situation, by water-bearing units

Water-bearing unit	Age (from youngest to oldest)	Maximum thickness near outcrop area [a] (feet)	Location of outcrop area in basin [b]	Yield of selected wells: Number of wells for which data on yields were obtained	Yield of selected wells: Range in depth of wells (feet)	Yield of selected wells: Median yield (gpm)	Yield of selected wells: Range of yield, based on 4 out of 5 wells (gpm)	Chemical quality of water in selected wells and springs (median values): Number of analyses represented by data	Iron (Fe) (ppm)	Sulfate (SO_4) (ppm)	Chloride (Cl) (ppm)	Dissolved solids (ppm)	Hardness as $CaCO_3$ (calcium, magnesium) (ppm)	Average use of water in 1965 (mgd)
				UNCONSOLIDATED MATERIALS (Water occurs in spaces between grains)										
Alluvium	Recent	About 50	Stream valleys	Few wells in alluvium	---	---	Yields probably highly variable	---	--	--	--	--	--	--
Sand and gravel (coarse-grained stratified deposits)	Pleistocene (glacial epoch)	[c] 600	Mainly valleys and other lowlands	57 (municipal and industrial wells only)	10-329	100	20-700	Chemical concentrations somewhat similar to, but often lower than those of water from the underlying bedrock, as shown below (see also table 8)						8
Clay or silt or muck (fine-grained stratified deposits, sometimes also including fine-grained sand)			Many low or flat areas	---	---	---	Yield little or no water to wells	---	--	--	--	--	--	--
Till (unsorted mixture of fine- and coarse-grained materials)			Mainly uplands	---	---	---	Yield no more than a few gpm; sometimes no water at all	---	--	--	--	--	--	--
			BEDROCK (Water occurs mainly in fractures, joints, and bedding planes, but also in solution cavities in gypsum-bearing shale and in limestone and dolomite)											
Upper shale-sandstone (includes some thin limestones near base)	Upper and Middle Devonian	4,000-4,400	Near surface in central and southern parts of basin	150	25-385	10	2-40	20-29	0.21	17	36	370	142	
Limestone-dolomite (includes dolomitic shale)	Middle Devonian and Upper Silurian	230	Near surface in central Genesee, northern Livingston, and southernmost Monroe Counties	18	36-300	10	5-160	10-20	.23	80	42	470	338	
Gypsum-shale (shale, gypsum-bearing shale, and dolomite; includes salt beds in central and southern parts of basin)	Upper Silurian	500	Near surface in northern Genesee and southern Monroe Counties	15	20-135	25	18-42	15-21	.08	367	14	878	617	> 4
Dolomite (includes some limestone)	Middle Silurian	200	Near surface in northernmost Genesee and north-central Monroe Counties	18	25-173	[d] 85	[d] 10-190	14-19	.05	76	12	418	372	
Lower shale-sandstone (predominantly shale; a few feet of limestone at top of unit)	Middle and Lower Silurian and Upper Ordovician	1,240	Near surface in Rochester	Few wells in this limited area	---	---	Most yields probably no more than a few gpm	No data	--	--	--	--	--	

[a] Thickness of bedrock from table 1.

[b] See plate 1 or figure 3 for locations of bedrock units at or near land surface (beneath unconsolidated materials); and see plate 2 for locations of unconsolidated materials.

[c] Combined thickness of all types of glacial deposits encountered at a single place; thickness of sand and gravel rarely, if ever, exceeds 200 feet at a single place, and most commonly is only a few tens of feet in thickness.

[d] Data mainly from industrial wells; median would have been lower, had yield data been obtained for more domestic wells.

deposits by precipitation or stream infiltration, and upon the storage and transmission capacities of the aquifer. Most sand and gravel deposits in the basin are of limited areal extent, seldom more than a few square miles, and a single deposit is usually less than 25 feet in thickness. Two or three mgd is probably the upper limit of development for any one of the larger sand and gravel aquifers in the basin. Present usage from such aquifers in the basin, as a whole, averages 8 mgd.

Fine-grained stratified deposits of clay, silt, and sand laid down in glacial lakes commonly yield only very small supplies of water. The fine-grained sand is the only water-bearing material from which the water is withdrawn; clay and silt yield no water.

Till, a poorly sorted mixture of clay, sand, and gravel, commonly has a low permeability and, therefore, yields very little water to wells. Sufficient supplies for domestic use can only be obtained from large-diameter dug wells.

Shale and, to a lesser extent, sandstone are the principal kinds of bedrock that underlie the glacial deposits in (1) the central and southern parts of the Genesee River basin (the upper shale-sandstone unit) and (2) in the northern half of the city of Rochester (the lower shale-sandstone unit). The lowest part of the upper shale-sandstone unit also contains several thin beds of limestone. Plate 1 and figure 3 show the part of the basin where these units supply water to wells drilled into bedrock.

Ground water in the shale-sandstone units occurs both in joints along bedding planes (nearly horizontal) and in vertical joints. These openings are usually so small and limited in number that yields of wells commonly are only a few gallons per minute. A few wells have yields of more than 25 gpm. These larger yields occur where fracturing has been greater, such as in some sandstone beds, and at the eroded upper surface of the unit. Part of the water in some bedrock wells may also be derived from the overlying glacial deposits if the casing does not completely seal off these surficial materials.

Ground water in the other three water-bearing bedrock units in the basin -- limestone-dolomite unit, gypsum-shale unit, and dolomite unit -- also occurs in bedding-plane and vertical joints, but many of these fractures have been enlarged by the solution of the carbonate minerals in limestone and dolomite, and of gypsum which occurs in the gypsum-bearing Camillus Shale. Therefore, yields of wells drilled into these units are commonly several tens of gallons per minute, and sometimes exceed 100 gpm.

Chemical Quality of Ground Water

Most of the ground water in the Genesee River basin is of good enough quality to drink with little or no treatment, even though the water has a high "hardness" (often more than 180 ppm), and sometimes contains a high concentration of dissolved solids (more than 400 ppm). The composition and concentration of these dissolved constituents reflect the type and composition of rocks through which the ground water has moved. Most of the low dissolved-solids concentrations are found in the southern part of the basin where the principal type of bedrock is shale. The high concentrations found in the northern part of the basin occur in water from limestone and dolomite and from gypsum-bearing shale. The chemical quality of water in sand and gravel is usually somewhat similar to that in the bedrock except that the water is often, but not always, less mineralized than the water in the bedrock.

A few chemical characteristics of ground water in bedrock are shown in table 2. The highest mineral concentrations in the Genesee River basin are found in water from the gypsum-shale unit. Much of the dissolved-mineral content is calcium sulfate, resulting from the dissolving of gypsum found in some parts of the shale of the Salina Group of rocks. Down dip to the south of the outcrop belt, the shale contains increasing quantities of salt instead of gypsum. Salt beds lie deeply buried under most of western New York and are mined in the central part of the basin.

As a result of solution of the buried salt, ground water at depth in, or above, the Salina Group is high in chloride. The salty water discharges slowly in the major valleys in the northern half of the area. A few wells intercept this discharge and yield water high in chloride.

Some of the principal chemical characteristics of ground water in the basin are shown in plate 1.

AVAILABILITY OF GROUND WATER FROM UNCONSOLIDATED DEPOSITS

Types of Deposits and Relative Importance

The unconsolidated deposits of the Genesee River basin may be subdivided into four categories:

1. Coarse-grained stratified deposits (Pleistocene).
2. Fine-grained stratified deposits (Pleistocene).
3. Alluvium (Recent).
4. Till (Pleistocene).

The occurrence of the Pleistocene (glacial) deposits is shown in plate 2. Thin alluvial deposits (not shown in plate 2) of clay, sand, and gravel, overlie the stratified glacial deposits in many valleys.

The best aquifers in the basin are the coarse-grained stratified deposits (sand and gravel) which occur at the land surface, or are buried beneath fine-grained materials. Typical yields of properly constructed wells in sand and gravel are between 100 and 700 gpm.

Saturated sand and gravel deposits are found in the valley of the Genesee River itself and in the valleys of some of its principal tributaries. Many of these deposits are buried beneath more than 100 feet of clay or silt, and are limited in width by the till and bedrock walls of the valleys. Similar sand and gravel aquifers are found in "buried valley" deposits -- those valleys of preglacial streams which have been largely or completely covered by glacial deposits. These include what may have been the preglacial courses of the Genesee River from south of Portageville northeastward to Sonyea and from Avon eastward to Ontario County and then northward to Irondequoit Bay. The approximate course of this latter valley is shown near the southern and eastern margin of figure 5, a map of bedrock topography in Monroe County

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Figure 5.--Bedrock contour map of Monroe County (Leggette and others, 1935).
IN POCKET WITH PLATES

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published by the Monroe County Planning Board in 1935. Other important sand and gravel aquifers are the more areally extensive glacial outwash deposits which occur at the surface in several places in the central part of the basin.

The fine-grained deposits (mainly clay and silt, and sometimes muck) are usually confining beds rather than aquifers except where a domestic well may penetrate fine-grained sand interbedded with the clay and silt. The till is also a poor or nonyielding aquifer except where it contains streaks of sand. With respect to wells in till, sufficient water supplies for domestic use can only be obtained from large-diameter dug wells.

Alluvium, deposited by streams in Recent time, is composed of sand, gravel, and clay or silt. This content of fine-grained materials causes these deposits to have a low permeability and, therefore, yields from individual wells in alluvium are low, although higher yields are obtainable when the alluvium contains very little clay and silt. Beneath the alluvium in the larger stream valleys is a considerable thickness of glacial deposits, including water-bearing beds of sand and gravel which furnish moderate or high yields to wells.

The combined thickness of unconsolidated materials (depth to bedrock) is greatest in lowland areas and smallest in the uplands. The deposit on many of the upland areas is till, usually between a few feet and a few tens of feet in thickness. In the valleys and on some hillsides, a deposit may be sand and gravel, clay, or till, and in many of the larger valleys the combined thickness of these glacial deposits is several hundred feet. The thickness of unconsolidated materials (depth to bedrock) at more than 100 well sites in the basin is listed in column 8 of appendix table A-1, and these well sites are identified by well number in plate 1. As indicated in the last column of table A-1, drillers' logs of many of these wells are in table A-2 of the appendix.

Much of the greater thickness of glacial deposits at most well sites in valleys is composed of fine-grained materials -- clay, silt, and sometimes fine-grained sand. Clay and silt are also interbedded in many of the deposits of sand and gravel. This lack of thick, "clean" sand and gravel deposits is the principal reason that there are very few wells which yield as much as 500 gpm.

An inspection of drillers' logs reveals that wells drilled in the principal valleys in most of the river basin south of Portageville penetrate the following sequence of deposits, from top to bottom:

Deposit	Thickness (feet)
Sand and gravel, and silt or clay (alluvium, generally not water bearing, except at mouths of tributary streams)	5-30
Clay, or silt and clay (may include some till)	80-220
Fine sand, or sand and gravel (water bearing)	5-30
Bedrock (at a depth of between 100 and 300 feet)	

This same geologic "picture" may also apply to much of the broad valley of Canaseraga Creek between Dansville and Mount Morris, and to the Genesee River valley from Mount Morris to Avon except that the beds of clay and silt (and probably some fine-grained sand) may have a combined thickness of 300 or 400 feet, instead of the 220 feet noted above.

A brief review of several sequences of glacial deposition will provide a better understanding of the occurrence of some of the coarse- and fine-grained stratified deposits. Most of these materials were deposited as the glacier was receding northward, or halted temporarily in its recession. Much of this time the southern "front" of the glacier dammed a series of large lakes which were forced to find outlets to the south, east, or west. The lakes were widest near the glacier and extended finger-like up into the valleys having higher elevations. At the foot of the receding glacier was deposited sand and gravel (and lesser amounts of clay and silt) which had been previously picked up by the advancing glacier. As the glacier continued to recede, this coarse-grained layer on the lake bottom was covered by thick deposits of clay and silt.

Additional layers of sand and gravel were deposited from time to time along the margins of the lakes at the mouths of tributary streams flowing into the lake. These deltas of coarse materials interfinger with the adjacent lake-clay deposits. Therefore, the reaches of the valleys where deltaic deposits were formed contain a greater thickness of sand and gravel than do the interdelta areas either near the center of the deeper valleys or at places distant from the mouths of tributaries. The composite geologic log shown above represents the interdelta type of deposition, while the driller's log of well 213-801-1 (table A-2) at Belmont, near the mouth of Phillips Creek, represents deltaic deposition. The latter log shows sand or sand and gravel from land surface to bedrock at 252 feet except for a clay layer between the depths of 95 and 105 feet. Clay also was reported along with the coarse-grained materials at almost all other depths. Only 9 feet of the log showed no clay.

The third type of glacial deposition, which resulted in coarse-grained materials, occurred after the lake or lakes had been drained from the immediate area of the glacier. Then the melt-water streams flowing out from the glacier were able to carry their heavy sediment load a considerable distance away from the glacier. These coarse outwash materials were deposited as fans and flood-plain deposits on top of the finer grained lake deposits now drained. The outwash deposits were most extensive when the glacier halted a long time at one place before resuming its recession.

Sand and Gravel Deposits

There is a wide distribution of sand and gravel deposits in the basin, as indicated in plate 2. Substantial quantities of ground water are available from two types of shallow deposits of sand and gravel shown in plate 2 by the symbol for "coarse-grained stratified deposits." The first type consists of glacial-outwash deposits, several tens of feet in thickness in some places and of wide areal extent. They occur southeast of Dansville in Livingston and Steuben Counties and southeast of Caledonia in Livingston County and are among the largest yielding water-bearing deposits in the basin.

The second type of surficial sand and gravel deposit that may yield substantial water is found at the mouths of many of the tributaries of the Genesee, especially between Portageville and the Pennsylvania State line. Each summer or autumn much of the streamflow, a short distance upstream from the mouth, enters the gravel deposit and flows underground into the Genesee River.

Important subsurface deposits of water-bearing sand and gravel occur in most of the principal stream valleys in plate 2 where the map symbols indicate "coarse-grained stratified deposits" lying beneath fine-grained materials. These subsurface deposits are more than 100 feet below the land surface in the larger valleys, such as the valleys of the Genesee River and of lower Canaseraga Creek. Most of these subsurface deposits are between 5 and 30 feet in thickness.

Transmissibility and Permeability

Drillers have made specific-capacity tests at many of the sites where they have drilled municipal and industrial wells in sand and gravel. Such data, along with the driller's log of each well, make possible the estimation of part of the hydraulic characteristics of aquifers. Based upon graphical methods of Walton (1962, p. 12-13), estimates of transmissibility are presented in table 3 and figure 6. The coefficients of transmissibility and permeability are measures of an aquifer's capacity to transmit water. By definition, the coefficient of permeability applies to 1 foot of aquifer thickness and the coefficient of transmissibility to the total thickness of an aquifer. Therefore, average permeability at a given place equals transmissibility divided by the thickness of the aquifer at that place, provided that the conditions of aquifer testing and analyses take into account limitations caused by head loss at the screen, partial penetration of the aquifer, and the effects of aquifer boundaries. In units most convenient for application to field conditions, the coefficient of transmissibility is expressed as the rate of flow of water at the prevailing water temperature, in gallons per day, through a vertical strip of the aquifer 1 mile wide measured at right angles to the direction of flow and extending the full saturated height of the aquifer under a hydraulic gradient of 1 foot per mile.

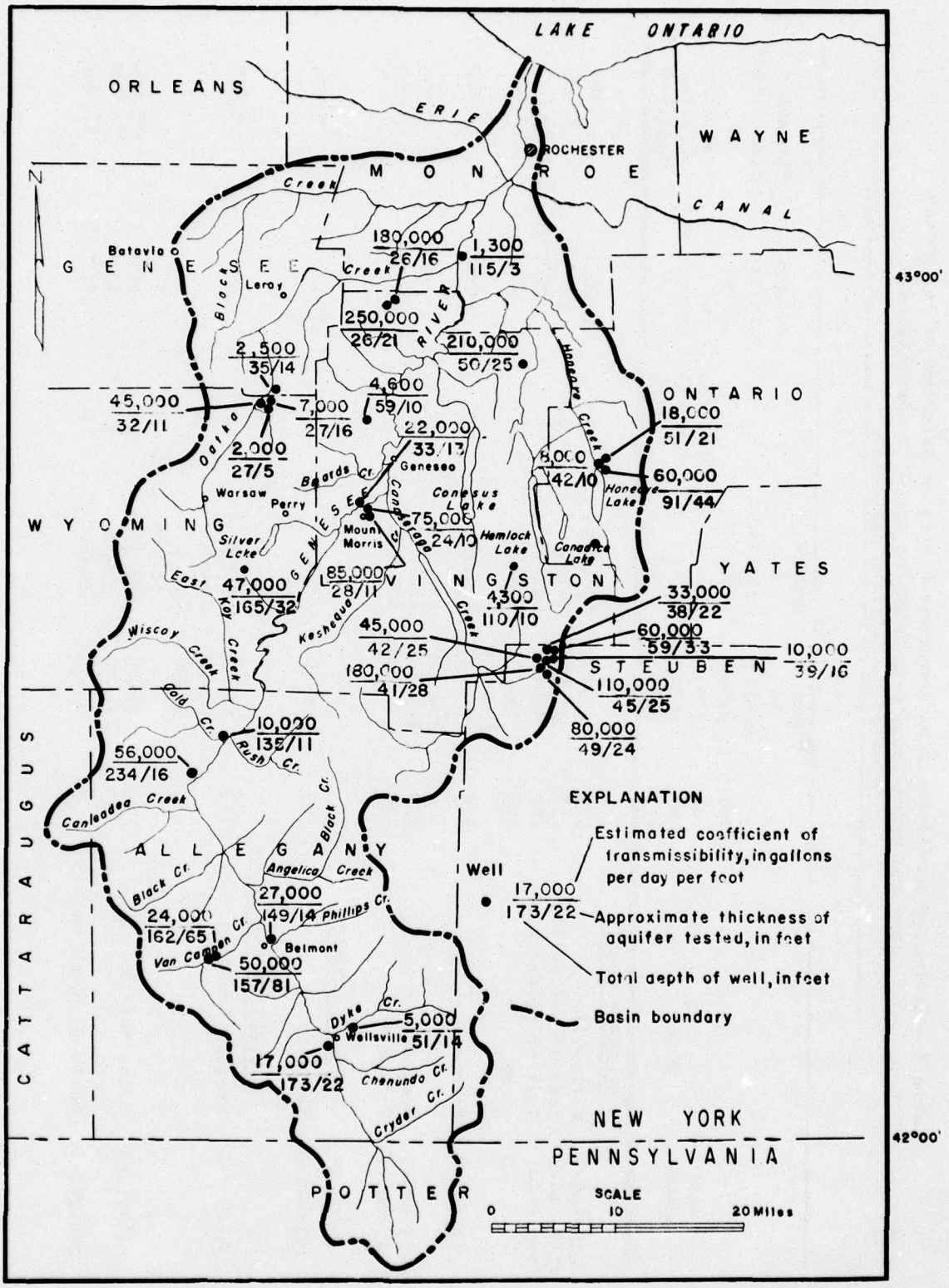


Figure 6. Estimated coefficients of transmissibility at selected wells in sand and gravel aquifers, based on specific-capacity data.

Table 3.--Estimated coefficients of transmissibility at selected wells tapping sand and gravel aquifers, based on specific-capacity data provided by drilling companies

Well number	Place	Depth of well (ft)	Depths to aquifer tested; top-bottom (ft)	Depths to screened interval; top-bottom (ft)	Specific capacity (gpm/ft)	Assumed coefficient of storage [a]	Estimated coefficient of transmissibility (gpd/ft)
	ALLEGANY COUNTY						
206-756-9	Wellsville	173	151-173	151-173	7.2	0.0001	17,000
207-754-2	East of Wellsville	51	37-51	41-51	4.8	.2	5,000
212-806-1	East of Friendship	162	97-162	142-162	11	.0001	24,000
-2	do.	157	78-151, 153-161	128-150	22	.0001	50,000
214-802-1	Belmont	149	133-137, 140-150	138-149	13	.0001	27,000
225-809-1	Houghton	234	215-231	222-228	24	.0001	56,000
227-806-1	Fillmore	135	123-134	127-134	5	.0001	10,000
	GENESEE COUNTY						
252-801-1	Pavilion	35	16-30	25-30	2.6	.2	2,500
	LIVINGSTON COUNTY						
240-737-1	Webster Crossing	110	60-62, 80-82, 92-98	92-98 (temporary screen)	2.6	.0001	4,300
243-752-3	Mount Morris	24	14-24	19-24	33	.0001	75,000
-4	do.	28	17-28	23-28	38	.0001	85,000
244-752-1	North of Mount Morris	33	20-33	24-33	11	.0001	22,000

Table 3.--Estimated coefficients of transmissibility at selected wells tapping sand and gravel aquifers, based on specific-capacity data provided by drilling companies (Continued)

Well number	Place	Depth of well (ft)	Depths to aquifer tested; top-bottom (ft)	Depths to screened interval; top-bottom (ft)	Specific capacity (gpm/ft)	Assumed coefficient of storage a/	Estimated coefficient of transmissibility (gpd/ft)
	LIVINGSTON COUNTY (Cont'd.)						
250-753-2	South of York	59	23-30, 32-35	30-35 (temporary screen)	2.1	0.0001	4,600
254-738-2	West of Lima	50	18-43	32-42	88	.0001	210,000
258-750-5	Caledonia	26	13-27, 33-37, 39-42	21-26	175	.2	250,000
-6	do.	26	10-26	16-26	120	.2	180,000
	MONROE COUNTY						
302-743-2	East of Scottsville	115	48-51	48-51 (temporary screen)	.7	.0001	1,300
	ONTARIO COUNTY						
247-730-1	Honeoye	42	31-41	36-41	4.2	.0001	8,000
-2	do.	51	32-53	41-51	8.4	.0001	18,000
-4	East of Honeoye	91	52-96	84-95	48	.2	60,000
	STEUBEN COUNTY						
233-734-3	Wayland	39	28-44	34-39	5.1	.0001	10,000
233-735-1	South of Wayland	49	25-49	25-45	58	.2	80,000

Table 3.--Estimated coefficients of transmissibility at selected wells tapping sand and gravel aquifers, based on specific-capacity data provided by drilling companies (Continued)

Well number	Place	Depth of well (ft)	Depths to aquifer tested; top-bottom (ft)	Depths to screened interval; top-bottom (ft)	Specific capacity (gpm/ft)	Assumed coefficient of storage [a]	Estimated coefficient of transmissibility (gpd/ft)
	STEUBEN COUNTY (Cont'd.)						
233-735-3	Wayland	42	17-42	36-42	19	0.0001	45,000
-4	do.	45	17-42	35-45	47	.0001	110,000
-6	do.	41	10-14, 19-43	36-41	75	.0001	180,000
234-735-3	do.	38	16-38	28-38	28	.2	33,000
-4	do.	59	26-31, 34-62	49-59	27	.0001	60,000
	WYOMING COUNTY						
239-804-2	Silver Springs	165	140-172	150-165	21	.0001	47,000
251-802-1	South of Pavilion	32	21-32	22-27	21	.0001	45,000
-2	do.	27	6-16, 21-27	22-27	6.2	.2	7,000
-3	do.	27	14-15, 17-21	17-22	2.3	.2	2,000

[a] Assumed values of coefficient of storage and estimates of coefficients of transmissibility were obtained on basis of methods used by Walton (1962, p. 12-13). The assumed coefficient of storage for artesian aquifers is 0.0001, and for water-table aquifers is 0.2.

In order to estimate the coefficient of transmissibility from specific-capacity data, it is necessary to assume a value for the coefficient of storage. The coefficient of storage is the ratio of (1) the volume of water released from storage per unit area of the aquifer to (2) the unit loss of head, such as a 1-foot drop in artesian pressure or a 1-foot decline in level of the water table. The assumed coefficients of storage shown in table 5 are those used by Walton (1962, p. 12-13). The concepts of permeability, transmissibility, and storage are precisely defined along with discussion of their significance, hydrologic assumptions, and field limitations in a publication by Ferris and others (1962), from which the brief explanations above were adapted. The data as used here are no more than "rough estimates," but they are a means of approaching the right order of magnitude necessary in order to make other hydrologic computations which have some quantitative meaning.

From a review of the data in table 5, a permeability of 1,000 gpd per sq ft (gallons per day per square foot) was selected as representative of most of the sand and gravel aquifers in the Genesee River basin. Higher permeabilities do occur in some parts of the basin, such as an estimated 3,000 gpd per sq ft at Wayland, and an estimated 10,000 gpd per sq ft at Caledonia.

Yields of Aquifers

Two or three mgd is probably the upper limit of development for any one of the larger sand and gravel aquifers in the basin, but further drilling and aquifer testing would be needed to check the validity of this conclusion. Most sand and gravel deposits are of limited areal extent, seldom more than a few square miles, and a single deposit is usually less than 25 feet in thickness, often much less. The principal areas where substantial quantities of ground water may be obtained at shallow depths are (1) the Wayland-Perkinsville area in Steuben County, (2) the East Koy-Gainesville-Lamont area in Wyoming County, (3) the Canawaugus-Caledonia area in Livingston County, and (4) an area east of Canaseraga in Allegany County.

Other locations of moderate or large supplies of ground water from shallow deposits of sand and gravel are principally at the mouths of streams where these streams have built small deltas of coarse-grained materials in the major valleys. Many of the tributaries of the Genesee River have delta deposits of this kind, especially in Allegany County. Water enters such deposits by infiltration from the tributary stream and can be withdrawn through wells drilled immediately adjacent to the mouth of the stream.

Table 4 contains estimates of dependable ground-water yield at the mouths of 21 streams in the basin, listed in downstream order. The dependable yield at 12 of the sites is shown as a range of values instead of a single value because of the uncertainty as to the storage

Table 4.--Preliminary estimates of dependable yield of infiltration water supplies from sand and gravel deposits at the mouths of 21 streams

Note: "Dependable yield," as given below, is the maximum amount of water which can be withdrawn continuously from a group of wells at or near the mouth of the stream. These estimates are based on the assumption that the permeable deposits at the stream mouth have a dependable yield equal to a specific quantity of streamflow somewhere within a range of that which is equaled or exceeded between 80 and 98 percent of the time. The "80-percent" estimates apply only if the ground-water storage capacity is large.

Tributary stream and location (in downstream order)	Approximate drainage area at mouth (sq mi)	Estimate of dependable yield: Streamflow equaled or exceeded... 98 percent of time (gallons per day)	80 percent of time (gallons per day)	Main (receiving) stream
Marsh Creek at Mapes	12	200,000	(a/)	Genesee River
Chenunda Creek at Stannards	31	700,000	2,000,000	do.
Elm Valley Creek at Elm Valley	11	60,000	300,000	Dyke Creek
Brimmer Brook northwest of Wellsville	8	300,000	(a/)	Genesee River
Vandermark Creek at Scio	23	200,000	1,000,000	do.
Phillips Creek at Belmont	31	800,000	2,000,000	do.
Van Campen Creek at Belvidere	58	900,000	(a/)	do.
White Creek near Belfast	15	70,000	500,000	do.
Black Creek at Belfast	30	100,000	(a/)	do.
Wigwam Creek near Belfast	15	70,000	600,000	do.
Crawford Creek at Oramel	11	100,000	600,000	do.
Cold Creek at Fillmore	42	2,000,000	(a/)	do.

Table 4.--Preliminary estimates of dependable yield of infiltration water supplies from sand and gravel deposits at the mouths of 21 streams (Continued)

Tributary stream and location (in downstream order)	Approximate drainage area at mouth (sq mi)	Estimate of dependable yield Streamflow equaled or exceeded... 98 percent of time (gallons per day)	80 percent of time (gallons per day)	Main (receiving) stream
Rush Creek near Fillmore	41	300,000	2,000,000	Genesee River
Wiscoy Creek at Rossburg	109	6,000,000	(a/)	do.
Ewart Creek at Swain	4	90,000	200,000	Canaseraga Creek
Keshequa Creek at Sonyea	70	600,000	3,000,000	do.
Beards Creek near Leicester	49	40,000	200,000	Genesee River
Christie Creek south of Canawaugus	15	100,000	(a/)	do.
White Creek at Canawaugus	6	800,000	(a/)	do.
Mill Creek at Honeoye	13	400,000	(a/)	Honeoye Creek
Stony Creek at Warsaw	9	60,000	500,000	Oatka Creek

a/ An estimated upper limit of possible yield is omitted because no observations nor measurements have been made to date in order to confirm or define infiltration at this site. For this same reason, the lower estimate should be used with caution, and considered mainly in the sense of being worthy of further investigation.

capacity of the coarse-grained deposits. Still less is known of the water-yielding capacity at the other 9 sites in table 4 and, therefore, only the "lower" value of the range of estimates is listed in the table. If at a particular place there were a large storage capacity, ground water would be withdrawn at least partly from storage during the period of time when streamflow was lowest (and infiltration was lowest), and under these circumstances the dependable yield would approach the upper end of the range shown in table 4 provided the transmissibility were high enough to receive and yield water at this rate. If there were very little storage capacity, the lower rate of infiltration (streamflow exceeded 98 percent of time) would be more nearly correct. Exploratory drilling and a pumping test would be necessary to determine accurate values. Such exploration would also be necessary in order to learn whether or not the permeable delta deposits extended from the tributary valley to and beneath the receiving stream, usually the Genesee River; if such a connection existed, infiltration supplies could also be obtained from that main stream.

Most of the present ground-water developments withdrawing water from sand and gravel deposits are in parts of valleys where there are no deltaic deposits. For such interdelta areas, the available data suggest that supplies of only moderate size can be obtained because (1) the coarse-grained deposits are relatively thin, (2) they are not in close hydraulic connection to a stream, and (3) the deposits often contain clay, silt, or very fine sand in some of the same beds with the more coarse-grained sand and gravel. Dependable yields from these deposits at any one place probably range from 200,000 to 1,000,000 gallons per day. Such yields would probably apply to many parts of the Genesee River valley in Allegany County and to much of the Canaseraga Creek valley in Livingston County as well as to individual aquifers in buried glacial valleys, such as the one that extends from Avon eastward through Monroe County to the northwestern corner of Ontario County.

It is emphasized that this whole matter of estimating "dependable yields" is subject to many assumptions and, therefore, requires more geologic and hydrologic data before the computations and estimates can become reliably accurate. However, the present estimates are intended to be a step in the right direction and help to indicate where further work is needed and justified.

AVAILABILITY OF GROUND WATER FROM BEDROCK

Throughout most of the Genesee River basin, bedrock is not a present or potential source of large or moderate supplies of ground water. Yields greater than 50 gpm from a single well are unusual, most yields are less than 10 gpm, and 1 or 2 gpm is not uncommon. "Dry holes" sometimes result from drilling in bedrock, such as in a shale having very few fractures capable of holding and yielding water. Although there are some exceptions to the above, rather "negative" view of ground water in bedrock, the point to be made is that bedrock wells are primarily a source of water for privately owned homes and small farms having modest water needs. Most larger water users should seek their water supply from wells in sand and gravel or from streams and lakes.

The principal exceptions to low yields from bedrock are wells in the northern part of the basin which penetrate cavities resulting from the solution of gypsum in gypsum-bearing shale (part of the Salina Group) and solution of limestone or dolomite rocks. Some of these wells reportedly yield more than 100 gpm. There are also some reported yields of this magnitude from a few bedrock wells in the southern part of the basin, but probably a part of the yield is also obtained from unconsolidated deposits (sand or sand and gravel) immediately overlying the bedrock.

Types of Deposits

The five water-bearing bedrock units into which bedrock in the Genesee River basin has been grouped for the records and discussion of this report are identified as:

Upper shale-sandstone
Limestone-dolomite
Gypsum-shale
Dolomite
Lower shale-sandstone

Each consists of gently dipping sedimentary rocks in which water occurs along joints and bedding planes, some of which have been widened by solution of carbonate minerals and gypsum. Most water wells are drilled no more than 300 feet into bedrock because the number of rock openings tend to decrease as depth increases. Also, water usually is more highly mineralized at increasing depths because of slow movement, lack of dilution from recent precipitation, and possible contact with salty waters associated with salt deposits which underlie most of western New York.

The water-bearing bedrock units, and the geologic formations of which they are composed, are listed in table 1 and shown in plate 1. They dip southward at 40 to 60 feet per mile. Therefore, the younger

rock units are exposed to the south and the older to the north. The upper shale-sandstone unit in the southern and central parts of the Genesee River basin is mainly shale, a lesser amount of sandstone, and some thin beds of limestone. North of north latitude 42°55', the limestone-dolomite unit and the dolomite unit flank the Salina Group of shales, including the gypsum-bearing Camillus Shale. At the extreme northern end of the basin is the lower shale-sandstone unit which includes the Clinton Group (mainly shales), Medina Group (of former usage, sandstone and shale), and the Queenston Formation (mainly shale). These last three groups and formations occur near the land surface in the Genesee River basin in an area of less than 20 square miles, entirely in Rochester.

Yields and Specific Capacities

The yields of wells in the shale-sandstone units are commonly only a few gallons per minute because the openings along bedding planes (nearly horizontal) and in vertical joints are usually very small and limited in number. A few wells have yields of more than 25 gpm. These larger yields occur where fracturing has been greater, such as in some sandstone beds or at the eroded upper surface of the unit, or partly from water in the overlying unconsolidated deposits.

Yields from wells tapping carbonate rocks or the gypsum-bearing shale are commonly several tens of gallons per minute and sometimes exceed 100 gpm. Ground water in these bedrock units -- limestone-dolomite unit; gypsum-shale unit; dolomite unit -- also occurs in bedding-plane and vertical joints. Many of these fractures have been enlarged by the solution of the carbonate minerals in limestone and dolomite, and of gypsum which occurs in the gypsum-bearing Camillus Shale. Some high-yielding bedrock wells may also draw water from nearby streams.

The specific capacity of a well, that is, its yield per foot of drawdown, is a convenient way of comparing the productivity of one well with another. Table 5 shows specific-capacity data for 14 bedrock wells as reported by the drillers or owners of the wells.

The specific capacity of the great majority of bedrock wells in the Genesee River basin is probably between 0.1 and 3.0 gpm per foot of drawdown even though higher rates are shown for nearly one-half of the tests listed in table 5. The reason most of these values were not lower is that the tests were too short, with the exception of those tests lasting 8 hours. When tests are very short and drawdowns are large, a significant part of the reported yield may not be the water yielded by the aquifer during the test but, instead, the water standing inside the casing at the beginning of the test, especially if the rate of pumping or bailing is low. Also, the water level is probably still declining at the end of short tests, and a longer test would result in a lower specific capacity.

Table 5.--Specific-capacity tests of bedrock wells in the Genesee River basin

Well number	Location	Depth of well (ft)	Yield of well during test (gpm)	Depth to water below land surface: Static level (ft)	Depth to water below land surface: Pumping level (ft)	Specific capacity (gpm/ft)	Length of test (hours)	Date
			Upper shale-sandstone unit					
ALLEGANY COUNTY								
202-746-1	Whitesville	141	110	5	22	6.5	--	1949
202-758-3	5 miles south of Wellsville	305	30 (bailing)	70	205	.2	2	June 1964
204-755-1	Stannards	180	33 (bailing)	98	110	2.8	--	1950
209-747-2	Andover	280	70 (bailing)	24	36	5.8	--	December 1952
210-758-1	Scio	256	126	75	127	2.1	--	1948
WYOMING COUNTY								
239-805-1	Silver Springs	242	115	+6	91	1.2	--	December 1957
POTTER COUNTY, PA.								
155-753-1	Ellisburg, Pa.	183	40 (bailing)	10	20	4	--	July 1963
			Limestone-dolomite unit					
GENESEE COUNTY								
259-759-1	LeRoy	225	160	86	99	[a/] 12	.2	May 1944
			Gypsum-shale unit					
GENESEE COUNTY								
301-754-1	4 miles northwest of Caledonia	40	40	0	40	1.0	8	July 1953
301-754-2	do.	105	90	21	46.4	3.5	8	July 1953
MONROE COUNTY								
302-743-1	2 miles northeast of Scottsville	110	18	30	85	.3	2.5	August 1953
			Dolomite unit					
MONROE COUNTY								
307-736-1	Rochester	59	about 100	17	32	about 7	--	about 1953
307-737-1	do.	66	75	11.5	40	2.6	8	August 1947
308-739-2	do.	115	45	15.1	50	1.3	--	September 1947

[a/] Based on a 10-minute drawdown test; a longer test might have resulted in a specific capacity of slightly less than 2 gpm per foot of drawdown.

An example of a specific capacity which is probably misleadingly high is shown in table 5 for well 259-759-1, which draws water from the limestone-dolomite unit. A review of other data obtained for this well reveals that the specific capacity would have been more like 1 or 2 gpm per foot of drawdown, instead of the reported 12 gpm per foot of drawdown shown in table 5, had the test been conducted for 8 or 24 hours instead of for only 10 minutes. The principal evidence is that when the well was operated continuously for air conditioning during the summer, the water level dropped below the bottom of the pump suction pipe at a depth of 198 feet below land surface when the pumping rate was 160 gpm. The suction pipe was then lowered to a depth of 208 feet, and the well gave satisfactory service. In July of 1941, depth to the static water level was 115 feet, so we may assume a summer drawdown of about 85 feet resulting in a specific capacity of slightly less than 2 gpm per foot of drawdown.

Specific capacities of bedrock wells are not likely to be greater than about 3 gpm per foot of drawdown during periods of pumping measured in days or weeks, unless a bedrock aquifer is drawing some of its water from an overlying or adjacent sand and gravel aquifer or from a nearby stream or lake. Interconnected aquifers of this kind are probably responsible for some of the higher than average yields (and, in some cases, the higher specific capacities) of bedrock wells supplying water to the villages of Andover, Bergen, Churchville, Friendship, Scio, Silver Springs, and Whitesville. Probably some of the high yields reported for wells in the dolomite water-bearing unit (the Lockport Group -- a dolomite and dolomitic limestone) occur as a result of recharge to the aquifer from the Genesee River or the Erie (Barge) Canal.

WATER LEVELS IN WELLS

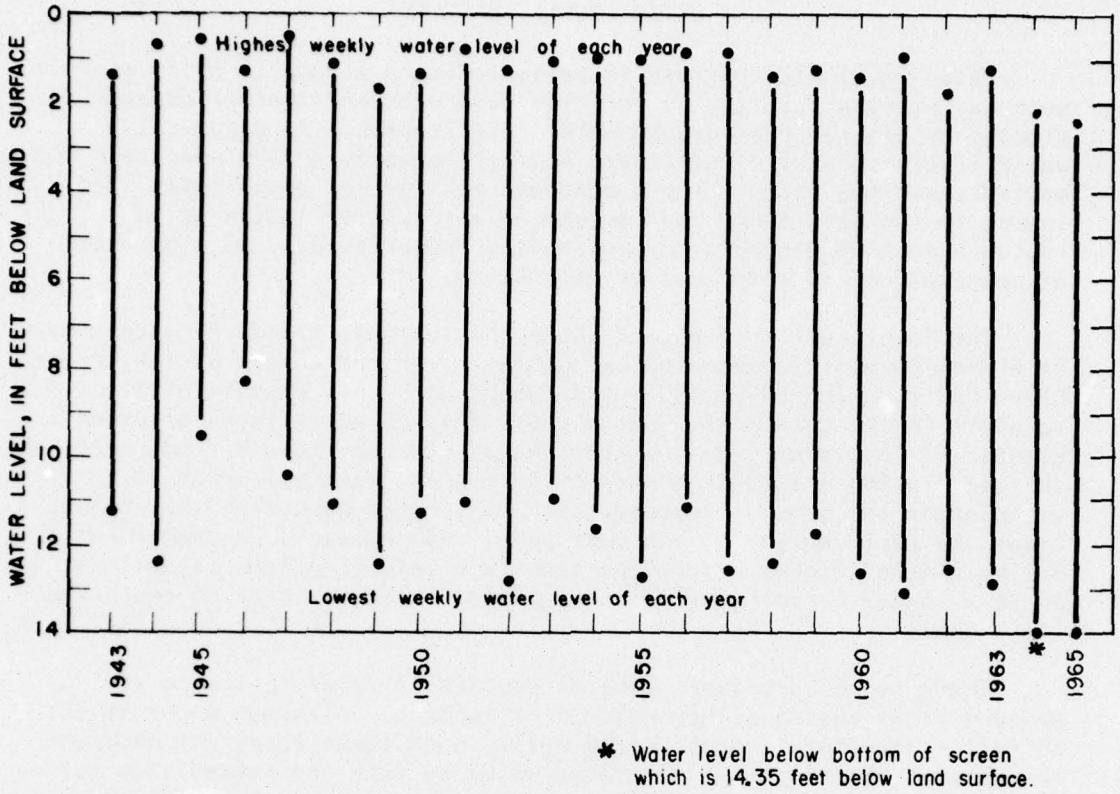
Water-level fluctuations in wells indicate change in water storage, such as increased storage by recharge from precipitation or decreased storage by discharge of ground water into streams. In a typical year, water levels in shallow wells are highest in early spring when rain and melted snow have entered the ground and reached the water table, and lowest in the late summer and autumn as a result of little or no replenishment of ground water during the summer because of high rates of evaporation and water use by vegetation.

The lower half of figure 7 shows the seasonal trends of water level in a shallow well (unaffected by pumping) near the center of the Genesee River basin during 1959, 1963, and 1965. Note that because of plentiful rainfall in the autumn of 1959, a sharp rise of water level occurred in October of that year. On the other hand, similar rises did not occur at the end of 1963 and 1965 because of only light rainfall prior to the freezing of the ground; instead, the rises occurred during the winter thaws and early spring of the next year. Water levels in deeper wells follow similar trends except for time lags resulting from situations where a longer travel time is required for recharge water to reach the water table.

There is no long-term, general decline of water levels in the Genesee River basin, either natural or manmade. Although water levels do fall when water is pumped from wells, such pumpage has not exceeded the natural replenishment of ground water by rain and melted snow during each autumn, winter, and spring in most parts of the Genesee River basin. Some years, and sometimes even a series of years, are drier than others, and water levels may drop sooner and farther than usual at such times, but when the first "wet" year comes along, the water levels return then (if not before) to their normally high levels of spring.

Note on the upper half of figure 7 that we are presently in a series of drier than average years (such as previously occurred in the northeastern United States in the 1930's). However, we may reasonably expect that sometime within the next few years, precipitation will occur in average or above average amounts and that, therefore, ground-water levels will return to such average early spring conditions as those shown by the high levels for the decade 1950-60.

In addition to seasonal variations in water level, there are variations which occur from place to place. The variations are related more directly to topography than to the type of aquifer. The water table in most places has a distinct, but "subdued" resemblance to the topography. That is to say, that the highest water levels (with respect to altitude) are beneath hilltops and the lowest levels are in valleys; however, the topographic gradients are steeper than the water-level gradients. Thus, a hilltop might be 200 feet above a valley bottom while the difference in ground-water level beneath those two points might be only 150 feet.



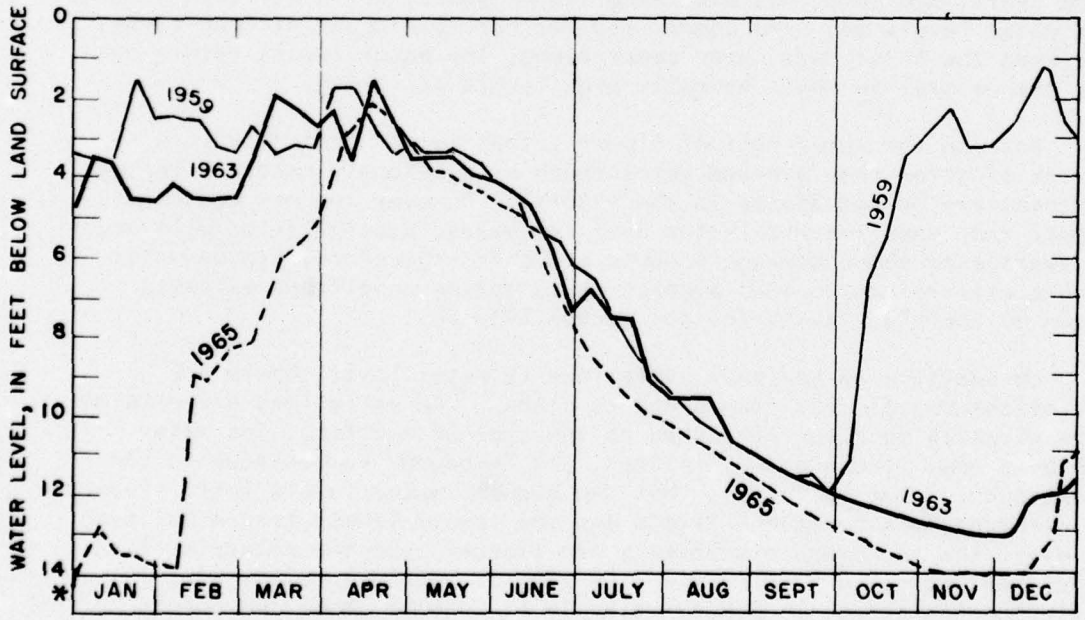


Figure 7. Weekly water levels in observation well Wo 1 (237-759-1), near Castile, Wyoming County, 1959, 1963, and 1965, and annual range of water-level fluctuations, 1943-65.

Depths to static-water levels in many wells in the Genesee River basin are less than 30 feet in wells located in valleys and also in some upland wells tapping shallow glacial deposits. In other places and deposits, water levels are usually within 80 feet of the land surface. Greater depths to water do occur, although limited mainly to some of the wells in the gypsum-shale and dolomite water-bearing units. The greatest depth to water measured, October 2, 1965, was 159 feet in well 258-759-1, which penetrates limestone at LeRoy, Genesee County. This well is about 2 miles south of the escarpment formed at the northern limit of the Onondaga Limestone. This limestone is drained of much of its ground water, a considerable distance south of its escarpment, by the end of each summer.

CHEMICAL AND PHYSICAL QUALITY

Ground water in the southern and central three-quarters of the Genesee River basin has a moderate to high dissolved-solids content (usually between 80 and 520 ppm), and is moderately hard to very hard (50 to 460 ppm). Nonetheless, the water in most of the wells is good to drink, and, except for softening, requires little or no treatment for such uses as cooling, washing, and irrigation. Ground water in the northern one-quarter of the basin is more highly mineralized (usually 320 to 2,000 ppm of dissolved solids), is very hard or extremely hard (240 to 1,500 ppm), and in some areas contains objectionable concentrations of sulfate. Small amounts of iron occur (usually less than 0.3 ppm) in water in most parts of the basin, and some well waters contain small amounts of hydrogen sulfide gas which may be removed by aeration. The hydrogen-ion concentration (pH) of most of the ground water in the basin is between 7.2 and 8.3.

A summary of chemical characteristics of ground water in the basin is given in table 6, arranged by bedrock units and the unconsolidated deposits which lie on top of them. The location of the bedrock units is shown in plate 1. Also shown in plate 1 are the locations of water-quality "zones" of shallow ground water (as determined by analysis of samples from wells and from streams at times of low flow), with particular reference to sulfate concentrations, dissolved-solids content, and hardness. The analyses on which the table and map are based are contained in appendix tables A-3 and A-5.

The chemical character of ground water is a reflection of the composition of the rocks through which the ground water moves. Shale and sandstone are less soluble than the other rock types, and that is why ground water in the central and southern parts of the basin contains less dissolved mineral matter than ground water in the northern part. Water in the upper shale-sandstone unit is at least partly of the sodium bicarbonate type in contrast to the water in the overlying deposits which is primarily of the calcium bicarbonate type.

The limestone-dolomite unit and the overlying deposits contain ground water mainly of the calcium-magnesium bicarbonate type because these three constituents are the principal and rather readily dissolved constituents of limestone and dolomite. In the gypsum-shale unit, the solution of gypsum or anhydrite, each composed of calcium sulfate, results in a water of the calcium sulfate bicarbonate type. Ground water in the dolomite unit is somewhat similar to that in the limestone-dolomite unit inasmuch as the water-bearing bedrock is dolomite and dolomitic limestone. The extremely high hardness of ground water in the northern part of the basin is a natural consequence of highly soluble, calcium and magnesium-bearing rocks through which the water moves inasmuch as calcium and magnesium are the hardness-producing elements or ions.

Table 6.--Representative chemical characteristics of ground water in the Genesee River basin

Note: These data represent the "middle 80 percent" of the chemical results, omitting the highest and lowest 10 percent of the chemical concentrations; however, no data were omitted for constituents analyzed less than 6 times.

Constituent (beneath each range of values is given the number of analyses included, which comprise that range)	Upper shale-sandstone unit		Limestone-dolomite unit		Gypsum-shale unit		Dolomite unit
	Bedrock (ppm)	Overlying deposits (ppm)	Bedrock (ppm)	Overlying deposits (ppm)	Bedrock (ppm)	Overlying deposits (ppm)	Bedrock (ppm)
Silica (SiO_2)	8.6-12	5.0-13	6.7-7.8	7.4-8.9	7.4-8.9	8.5	12
(number of analyses)	(4)	(14)	(3)	(2)	(2)	(1)	(1)
Iron (Fe)	.06-1.2	.02-1.3	.1-.64	.02-.07	.04-.19	.03-.87	.02-.89
(number of analyses)	(16)	(37)	(8)	(6)	(11)	(21)	(12)
Calcium (Ca)	11-64	26-112	57-147	80-151	80-332	86-358	62-132
(number of analyses)	(12)	(36)	(10)	(7)	(12)	(20)	(12)
Magnesium (Mg)	3.8-18	6.6-36	17-52	24-53	39-75	34-68	20-42
(number of analyses)	(12)	(34)	(10)	(7)	(12)	(20)	(12)
Sodium (Na)	31-95	4.7-64	29-74	20-75	12-24	82	9.2
(number of analyses)	(4)	(13)	(3)	(2)	(2)	(1)	(1)
Potassium (K)	1.6-2.3	.9-2.5	2.5-4.0	2.2-3.1	2.7-2.8	4.3	3.4
(number of analyses)	(4)	(13)	(3)	(2)	(2)	(1)	(1)
Bicarbonate (HCO_3)	148-296	104-375	192-408	189-492	232-412	240-436	211-337
(number of analyses)	(14)	(37)	(11)	(11)	(15)	(24)	(12)
Sulfate (SO_4)	1.4-4.3	.6-56	44-180	11-991	63-1,150	82-938	56-187
(number of analyses)	(23)	(43)	(16)	(12)	(16)	(23)	(14)
Chloride (Cl)	7.6-180	3-110	3.2-99	5-129	5-97	6.2-159	3-29
(number of analyses)	(23)	(43)	(16)	(12)	(17)	(24)	(15)
Nitrate (NO_3)	0-1.2	0-12	.1-135	.2-60	.5-15	.4-150	.2-60
(number of analyses)	(16)	(39)	(10)	(7)	(12)	(20)	(12)
Dissolved solids 1/	160-517	82-365	315-748	350-1,600	509-2,000	429-1,590	328-542
(number of analyses and estimates)	(23)	(43)	(16)	(12)	(16)	(23)	(14)
Hardness as $CaCO_3$ (Ca,Mg)	54-336	160-463	242-548	314-1,012	376-1,540	349-1,226	264-502
(number of analyses)	(23)	(43)	(16)	(12)	(17)	(24)	(15)
pH	7.6-8.2	7.2-8.1	7.4-8.3	7.4-8.1	7.6-7.9	7.4-8.1	8.0-8.2
(number of analyses)	(22)	(44)	(11)	(10)	(7)	(6)	(5)

1/ Where a dissolved-solids determination was not made in the laboratory, the laboratory-determined specific conductance was used to estimate the dissolved-solids content.

High chloride concentrations (greater than 100 ppm) occur in water from some wells in the upper shale-sandstone, limestone-dolomite, and gypsum-shale units, and to a lesser extent in the overlying sand and gravel deposits indicating that at least a part of the ground water found in such deposits circulated through underlying bedrock containing a source of salty water. Such deep circulation of ground water is similarly responsible for the high sulfate concentrations of water in sand and gravel deposits overlying the gypsum-bearing shale of the gypsum-shale bedrock unit. Also waters from separate sand and gravel aquifers at the same place may have major differences in chemical quality as was demonstrated in 1942 by samples obtained from well 300-737-2 in the buried valley near Rush, Monroe County. The hardness of water from an aquifer between 157 and 181 feet was 240 ppm, whereas water from an aquifer between the depths of 365 and 417 feet at the same well had a hardness greater than 2,000 ppm and a chloride concentration of 900 ppm.

Ground water from the great majority of wells in the central and southern parts of the Genesee River basin meets the chemical-quality standards normally specified for municipal water supplies. These standards include recommended maximum limits of concentrations of certain dissolved minerals as contained in the 1962 report of the U.S. Public Health Service. For example, neither chloride nor sulfate concentrations should exceed 250 ppm, nor total dissolved-solids content exceed 500 ppm, if alternative, less mineralized water supplies are available. In the northern part of the basin, the water from many wells does exceed these concentrations (table 6 and appendix table A-3), and some of it is unpleasant to drink even though not actually toxic.

The temperature of most ground water in the Genesee River basin is between 48° and 53° F, within a few degrees of the average annual air temperature. The temperature of ground water in wells drawing water from a depth of 30 feet or more does not vary more than a degree or two throughout the entire year, unless the well is recharged by infiltration of water from a nearby stream.

SANITARY QUALITY

Ground water in the Genesee River basin is generally safe to drink in its "raw," untreated form, directly from wells or springs, as indicated by the 62 sanitary analyses of ground water made by the New York State Department of Health during this study. Only four samples of raw water from ground-water sources showed by high counts of coliform bacteria -- an indication of probable pollution. However, an additional 21 of the 62 samples showed some degree of pollution. Possibly some of these 21 samples were contaminated during collection. The wells were not resampled to investigate this possibility. The raw water from three of the four sources showing high coliform counts is chlorinated before use to assure safe quality. The fourth source, a deep well (259-759-1 in Genesee County) in limestone is used only for air conditioning, not drinking. Although most ground water is safe to drink without prior treatment, disinfection is recommended as minimum treatment for all municipal water supplies to guard against and overcome unusual or unexpected contamination, regardless of the apparent purity of the source.

Appendix table A-4 contains all the sanitary analyses of ground water, and table 7 lists the median and extreme values from these analyses. All the values shown for nitrogen, ABS (alkyl benzene sulfonate, from detergents), and radium 226, are within limits recommended for safe use by major health authorities. The maximum values shown for chloride and hardness are a result of natural mineralization, not contamination. Causes for such mineralization are discussed in the preceding section on chemical and physical quality.

Ground water is susceptible to pollution wherever the saturated zone lies close to the land surface and the overlying materials are permeable enough to allow rapid infiltration. Of the glacial deposits found in the Genesee River basin, those most susceptible to pollution are the highly permeable, coarse-grained stratified deposits when the saturated zone of these deposits occurs at or very close to the land surface. For example, two of the wells from which samples indicating pollution were obtained are finished in sand and gravel deposits in which the saturated zone lies close to the surface (well 241-749-2 in Livingston County and well 214-802-3 in Allegany County). Carbonate rocks, such as the dolomite and dolomitic limestone of the Lockport Group, are the most pollution-prone types of bedrock because polluted water can travel relatively rapidly along solution-widened joints in such rocks. There are some places in the northern one-quarter of the basin where carbonate rocks occur at or extremely close to the land surface where till or clay are absent. In such areas, pollution from surface sources may be a present or future water problem.

A brief investigation was made in the autumn of 1965 to determine whether or not there was any contamination of ground water by pesticides. Water samples were collected from one well each in Livingston (257-749-2), Monroe (301-742-1), and Wyoming (239-809-1) Counties, at places where

Table 7.--Median and extreme values from sanitary and radiological analyses of ground water in the Genesee River basin

Constituent or characteristic	Number of analyses	Median	Minimum	Maximum
Temperature (at site) (°F)	63	54	46	73
(°C)	63	12	8	23
Color (units)	64	5	0	80
Turbidity (units)	62	2	0	50
Specific conductance (micromhos at 25° C)	65	400	87	2,450
pH	63	7.5	6.3	9.2
Carbon dioxide as CO_2 (ppm)	40	8	0	89
Coliform group (MPN/100 ml)	62	2.2	<2.2	>240
Bacteria (per ml agar, 36° C, 24 hours)	51	2	1	1,500
Chloride (Cl) (ppm)	65	23	1.5	525
Phosphates (PO_4) (ppm)	65	.2	<.1	4.5
Hardness as $CaCO_3$ (ppm)	65	200	20	1,480
Total alkalinity as $CaCO_3$ (ppm)	65	187	31	425
Residue on evaporation (ppm)				
Total	65	333	53	2,574
Volatile	65	107	0	575
Ammonia nitrogen as N (ppm)	65	.06	.004	4.00
Organic nitrogen as N (ppm)	65	.17	.03	3.98
Nitrite nitrogen as N (ppm)	64	.001	.001	.05
Nitrate nitrogen as N (ppm)	65	.04	.02	10.00
Total apparent ABS (ppm) (Alkyl benzene sulfonate)	62	<.03	<.03	.07
Radium 226 (picocuries per liter)	12	.13	.04	.33

pesticides were known to have been applied for some years in connection with farming operations. Analyses of these samples by the New York State Department of Health has shown no detectable concentrations of pesticides. Therefore, pesticide contamination of ground water probably does not occur in the basin at the present time to any significant extent.

MUNICIPAL GROUND-WATER SUPPLIES

There are 26 villages in the basin which use ground water as their principal source of supply. These places are listed alphabetically by county and village in table 8 and are located in figure 8. Total municipal usage of ground water averages about 2 million gallons per day, mainly from wells in sand and gravel. Ground-water use for municipal and other supplies is summarized in table 9. There has apparently been no major change in total ground-water use in the basin within the past 15 or 20 years. The population using ground water, probably about 75,000 people, is mainly rural and comprises about one-fifth of the total population of the basin.

At present the three largest municipal ground-water supplies are at Caledonia and Lima in Livingston County, and at Wayland in Steuben County, each averaging between 200,000 and 250,000 gallons per day withdrawn from wells in sand and gravel. Two new wells for the village of Dansville (at Perkinsville) will have a combined capacity of 2 million gallons a day when placed in use. The average per capita usage from municipal ground-water supplies in the basin in 1965 was 82 gallons per person per day. The low rate of use is a consequence of the relatively small amount of industry in the part of the basin served by these ground-water supplies. The per capita use of water is much greater in most of the Rochester metropolitan area (Monroe County).

Table 8.--Municipal water systems in the Genesee River basin using ground water as the principal source of supply

(Sources of information: Municipal water departments and publications of federal and state health agencies)

Water treatment: A - aeration; C - softening; D - chlorination; F - filtration; N - ammoniation; R - recarbonation; S - sedimentation; T - chemical taste and odor control; V - fluoridation

Village or place	Principal sources of water	Water treatment	Population served	Average use, 1964 (gallons per day)
	ALLEGANY COUNTY			
Andover	Many springs (207-748-Sp) Well 209-747-1 (100 gpm)	D None	1,300	100,000
Angelica	Spring 219-756-1Sp	None	900	50,000
Belfast	Well 220-806-1 (100 gpm)	A,C,D,F,V	800	39,500
Belmont	Well 214-802-1 (80 gpm) Well 214-802-2 (100 gpm)	C,F	1,200	82,600
Canaseraga	6 springs (229-748-Sp) in Livingston County, north of village	None	700	50,000
Fillmore	Well 227-806-1 (100 gpm) 5 springs	D None	500	60,000
Friendship	Well 212-807-1 (110 gpm) Well 212-807-2 (200 gpm) 7 springs	None None D	1,500	100,000

Table 8.--Municipal water systems in the Genesee River basin using ground water as the principal source of supply (Continued)

Village or place	Principal sources of water	Water treatment	Population served	Average use, 1964 (gallons per day)
	ALLEGANY COUNTY (Cont'd.)			
Houghton (System owned by Houghton College)	Well 225-809-1 (113 gpm) 6 or 7 springs (226-810-Sp)	C	1,615	71,000
Scio	3 springs (211-758-Sp) Well 210-758-1	None	600	35,000
Stannards (Stannards Cooperative Water System)	Well 204-755-1 (29 gpm) Well 204-755-2 (38 gpm)	None	350	14,000
Whitesville (Whitesville Water Co.)	2 springs (202-746-Sp) Well 202-746-1 (100 gpm) Well 202-746-2 (85 gpm)	D D D	500	35,000
	GENESEE COUNTY			
Bergen	Well 304-756-1 (350 gpm)	C,D	900	100,000
Pavilion	Well 251-802-1 (100 gpm) in Wyoming County Well 252-801-1 (100 gpm) in Genesee County	D None	400	35,000

Table 8.--Municipal water systems in the Genesee River basin using ground water as the principal source of supply (Continued)

Village or place	Principal sources of water	Water treatment	Population served	Average use, 1964 (gallons per day)
	LIVINGSTON COUNTY			
Caledonia	Well 258-750-5	None	1,700	250,000
	Well 258-750-6	None		
	Well 258-750-4	None		
Dansville	Well 232-737-4 (700 gpm)	D	(5,700)	(wells not yet in use)
	Well 232-737-5 (700 gpm) (wells in Steuben County)	D		
Lima	Well 254-738-2 (370 gpm)	C,D	1,600	210,000
Nunda	2 groups of springs (232-755-Sp)	C,D	1,300	140,000
	MONROE COUNTY			
Churchville	Spring 307-754-1Sp	D,V	1,000	80,000
	Well 306-752-1 (150 gpm)	D,V		
	ONTARIO COUNTY			
Honeoye	Well 247-730-1	None	1,000	100,000
	Well 247-730-2	None		
	STEUBEN COUNTY			
Wayland	Well 234-735-4 (700 gpm)	D	2,000	220,000

Table 8.--Municipal water systems in the Genesee River basin using ground water as the principal source of supply (Continued)

Village or place	Principal sources of water	Water treatment	Population served	Average use, 1964 (gallons per day)
	WYOMING COUNTY			
Bliss (Bliss Water Supply Co.)	Spring 233-816-2Sp	D	350	18,000
	Well 234-815-1	D		
Castile	Well 236-804-1	D	1,100	100,000
	Well 236-804-2 (60 gpm)	D		
Pike	Spring 233-810-1Sp	None	400	30,000
	Well 233-810-2	None		
	Well 233-810-3	None		
	Well 233-809-1 (16 gpm)	None		
Silver Springs	Well 239-805-1 (100 gpm)	A,D	730	50,000
	Well 239-805-2	A,D		
Wyoming	Well 249-804-1 (30 gpm)	None	500	30,000
	POTTER COUNTY (Pennsylvania)			
Genesee (Genesee Citizens Water Co.)	2 springs (159-751-Sp)	D	500	30,000
Ulysses (Lewisville Water Co.)	Spring 153-745-1Sp	D	600	25,000
	Well 154-745-1	D		
	Well 154-745-2	D		

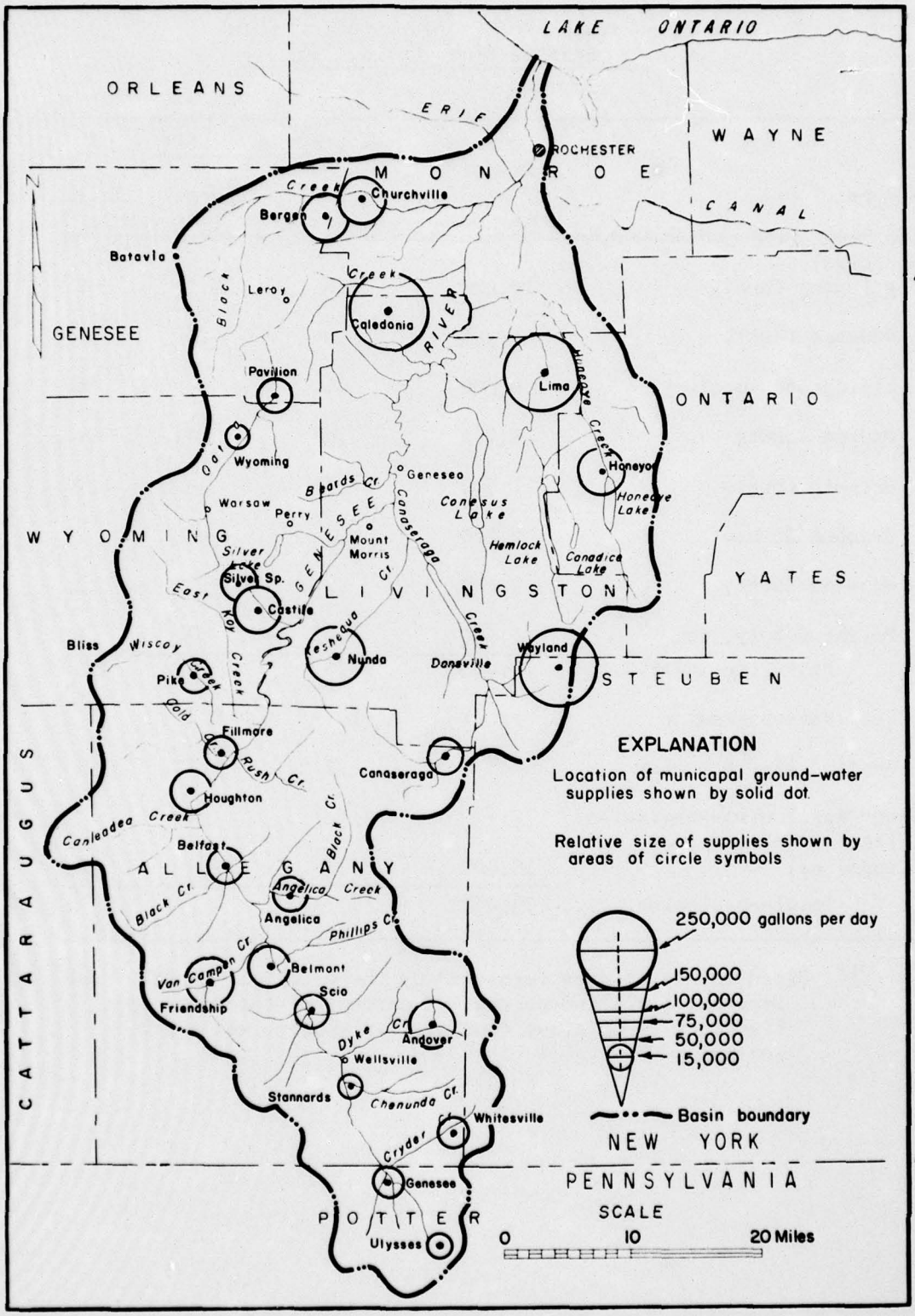


Figure 8. Location and size of municipal supplies using ground water as their principal source.

Table 9.--Average use of ground water in the Genesee River basin, 1965

Type of use	Number of people served	Water-bearing unit: Sand and gravel (million gallons per day)	Water-bearing unit: Bedrock (million gallons per day)	Total (million gallons per day)
Municipal				
Allegany County	10,000	0.4	0.2	0.6
Genesee County	1,300	.04	.08	.1
Livingston County	4,600	.6	--	.6
Monroe County	1,000	.04	.04	.1
Ontario County	1,000	.1	--	.1
Steuben County	2,000	.2	--	.2
Wyoming County	3,100	.2	.02	.2
Potter County, Pa.	1,100	.05	.01	.1
Basinwide total.....	24,000	1.6	.4	2.0
Industrial--basinwide		4	1	5
Livestock 1/--basinwide		1.2	1.2	2.4
Other rural uses--basinwide (excluding municipal supplies)	50,000	1.5	1.5	3.0
Total--basinwide.....	74,000	8	4	12

1/ Based mainly on data furnished by the U.S. Soil Conservation Service, and assuming that 75 percent of the water for livestock is obtained from privately owned wells and springs.

FUTURE DEVELOPMENT OF GROUND WATER

The largest potential supplies of ground water are in the valleys of the Genesee River and its principal tributaries where aquifers composed of stratified deposits of sand and gravel occur either near the land surface (such as at mouths of tributaries) or buried beneath finer grained stratified materials. Each well-field development in such aquifers will yield between 0.2 and 3 million gallons per day. The quality of water is best in the central and southern parts of the basin, but wells in the northern part of the basin may also be developed as supplementary or emergency water supplies. Future developments may increase total usage to at least several times the present average rate of use of 12 mgd.

Ground water will continue to be an important source of small water supplies for rural residents and farms in the central and southern parts of the basin from aquifers either in sand and gravel or in bedrock.

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Previous publications in this series which contain water-level data (by calendar years) for 2 or 3 wells in the Genesee River basin are as follows:

Water-Supply Paper	Year of water-level data	Water-Supply Paper	Year of water-level data
944	1942	1156	1949
986	1943	1165	1950
1016	1944	1191	1951
1023	1945	1221	1952
1071	1946	1265	1953
1096	1947	1321	1954
1126	1948	1404	1955
		1537	1956-57

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AD-A041 706 CORPS OF ENGINEERS BUFFALO N Y BUFFALO DISTRICT F/G 8/6
GENESEE RIVER BASIN COMPREHENSIVE STUDY OF WATER AND RELATED LA--ETC(U)
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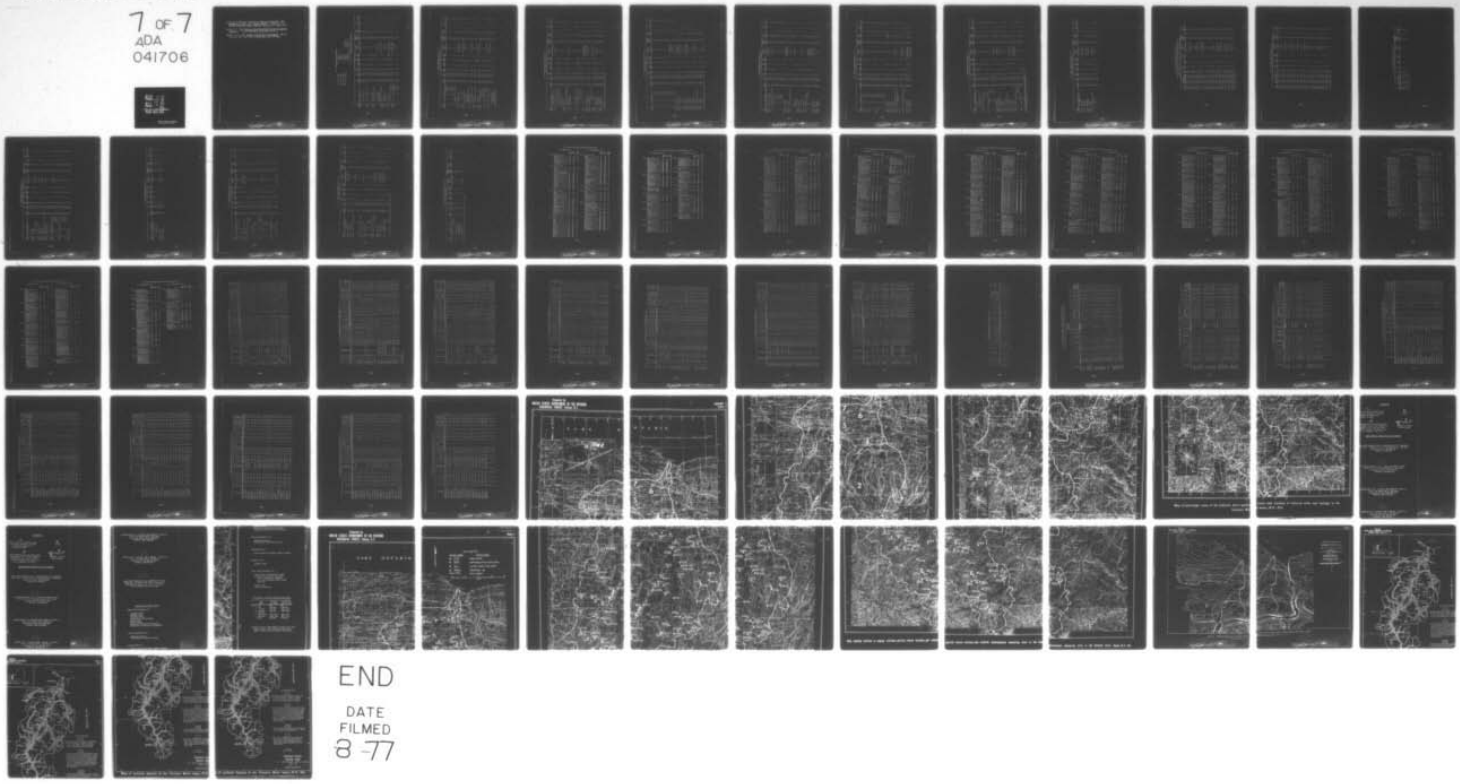

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Table A-1.--Records of selected wells and test holes

Year completed: a, about
b, before

Depth of well: a, about
m, measured

Depth of casing: a, about

Depth to bedrock: a, about
<, less than

Yield: e, estimated
f, flows
m, measured
r, reported
<, less than
>, greater than

Use: A, abandoned
C, commercial
D, domestic
I, industrial
N, institutional
O, water-level observations
P, public supply
S, livestock
T, test well or hole
U, unused
Y, destroyed
Z, auxiliary use only

Analysis in appendix: c, chemical analysis by U.S. Geological Survey
s, sanitary analysis by N.Y. State Dept. of Health

Part 1.--Allegany County, N.Y.

Well number	Owner or user	Year completed	Type of well	Depth of well (feet)	Diameter (inches)	Depth of casing (feet)	Depth to bedrock (feet)	Water-bearing material or unit	Altitude of land surface above sea level (feet)	Yield (gallons per minute)	Use	Analysis in appendix	Driller's log
202-746-1	Whitesville Water Co.	1949	drilled	141	8	89	--	Upper shale - sandstone	1685	100	P	c,s	yes
-2	do.	a1962	drilled	331	8	26	--	do.	1890	85	P	c,s	--
-5	Borden's Milk Products Co.	a1925	drilled	150	6	--	--	do.	1685	r 150	I	--	--
-6	do.	a1925	drilled	142	6	--	--	do.	1685	r 200	I	c,s	--
202-758-1	Bradley Producing Corp., Tullar Plant	1948	drilled	308	10	86	72	do.	1890	r 20	I	--	yes
-2	do.	1953	drilled	307	10	94	85	do.	1885	r 20	I	--	yes
-3	do.	1964	drilled	305	10	93	85	do.	1880	r 30	I	--	yes
204-754-1	Mark Rogers, Stannards	1927	drilled	450	8,6	250	250	do.	1570	f 1	U	c	--
204-755-1	Stannards Cooperative Water System	1950	drilled	180	8	16	a 16	do.	1650	29	P	c	--
-2	do.	1961	drilled	168	8	22	a 22	do.	1657	38	P	c,s	--
-3	Fred Peet Development	1946	drilled	159	8	51	--	Sand and gravel	1560	r 20	P	--	--
-4	Stannards Mobilehome Court	1956	drilled	112	8	--	--	--	1555	--	P	--	--
204-803-2	Bradley Producing Corp., Allen Plant	1946	drilled	300	10	34	28	Upper shale - sandstone	2000	r 100	I	--	yes
204-804-1	John Sloan	1929	drilled	350	8	40	--	do.	1940	r 10	I	c	--
205-755-1	Weimer Mobilehome Court	1960	drilled	185	8	185	--	Sand and gravel	1545	r 20	P	c	--
-2	H. F. Bunnell	1947	drilled	241	6	226	--	do.	1550	--	U	--	yes
205-801-2	M. A. Richardson	1962	drilled	127	6	105	a105	Upper shale - sandstone	1835	f 1	D	c	--
-3	Bradley Producing Corp., Yeager Plant	1946	drilled	85	10,8	33	75	Sand and gravel	2020	r 50	U	--	yes
205-802-1	do. Norton Plant	1946	drilled	300	10	104	104	Upper shale - sandstone	2060	r,f42	U	--	yes
206-756-1	Sinclair Oil Co., Wellsville (former owner) test well 1	1937	drilled	318	--	--	316	Sand and gravel	1490	--	T	--	yes
-2	do. test well 2	1937	drilled	114	--	--	--	do.	1495	r<75	T	--	yes
-3	do. test well 3	1937	drilled	46	--	--	46	do.	1515	--	T	--	yes

Table A-1.--Records of selected wells and test holes (continued)

Part 1.--Allegany County, N. Y. (continued)

Well number	Owner or user	Year completed	Type of well	Depth of well (feet)	Diameter (inches)	Depth of casing (feet)	Depth to bedrock (feet)	Water-bearing material or unit	Altitude of land surface above sea level (feet)	Yield (gallons per minute)	Use	Analysis in appendix	Driller's log
206-756-4	Sinclair Oil Co., Wellsville (former owner) test well 4	1937	drilled	162	--	--	--	Sand and gravel	1495	--	T	--	yes
-5	do. test well 5	1937	drilled	65	--	--	--	do.	1495	--	T	--	yes
-6	do. test well 6	1937	drilled	127	--	--	--	do.	1495	--	T	--	yes
-7	do. test well 7	1937	drilled	126	--	--	--	do.	1495	--	T	--	yes
-8	do. test well 8	1937	drilled	102	--	--	--	do.	1495	--	T	--	yes
-9	Walter Babbitt (former refinery well)	1937	drilled	173	10,7	151	--	do.	1490	r 75	T	--	yes
-10	Homer Le Bar	1940	drilled	72	6	42	42	Upper shale - sandstone	1495	r 250	I	--	yes
207-754-1	Air Preheater Co. well 3	1955	drilled	60	8	52	--	Sand and gravel	1515	r 4	U	--	yes
-2	do. well 2	1954	drilled	51	12,8	40	--	do.	1525	r 100	I	--	--
207-755-1	do. well 1	1950	drilled	254	6	203	203	Sandstone or sand and gravel	1530	r 50	I	c,s	yes
207-756-1	David A. Howe Memorial Library	1935	drilled	236	10,6	218	--	Sand and gravel	1505	r 60	O	--	yes
-3	Scoville Brown & Co.	1937	drilled	240	8,6	240	--	do.	1515	r 50	I	c,s	yes
-5	Super Duper Market (former site of Fresh Water Ice Co.)	a1930	drilled	255	6	250	--	do.	1520	r 125	Y	--	yes
209-747-1	Village of Andover	a1918	drilled	229	6	--	--	Upper shale - sandstone	1830	r 100	P,Z	c,s	--
-2	Bradley Producing Corp., Conley well	1952	drilled	280	10	36	28	do.	1715	r 70	U	--	yes
209-748-1	Sunnydale Farms, Inc.	a1915	drilled	a210	8	--	--	do.	1645	r 120	I	c,s	--
210-757-1	Bradley Producing Corp., Reagan Plant	1944	drilled	143	8	1/ 70 (136)	--	Sand and gravel	1540	r 58	U	--	--
210-758-1	Village of Scio	1948	drilled	256	10,8	154	a100	Upper shale - sandstone	1585	r 110	P	c,s	--
211-803-1	Harold Kane (Quaker State well 1)	a1948	drilled	280	8	45	--	do.	1980	m 38	D	c	--
212-804-1	do. (Quaker State well 4)	a1949	drilled	300	8	65	--	do.	1810	r 50	Y	--	--
-2	do. (Quaker State well 5)	1953	drilled	102	8	56	--	do.	1675	r 53	Y	--	--
212-806-1	Friendship Dairies, Inc. north well	1958	drilled	162	8	142	--	Sand and gravel	1475	r 300	I	--	yes
-2	do. south well	1955	drilled	157	8	135	--	do.	1470	r 300	I	c,s	yes
212-807-1	Village of Friendship hill well	1936	drilled	217	10	a 60	--	Upper shale - sandstone	1600	m 110	P	c,s	--
-2	do. valley well; test hole T-5	1948	drilled	276	10	106	91	do.	1480	r 200	P	c,s	yes
-3	Friendship Dairies, Inc. (former Gilt Edge Cheese site)	1946	drilled	165	8	95	95	do.	1485	r 90	U	--	yes

1/ Casing slotted from 70.5 to 77.5 feet.

Table A-1.--Records of selected wells and test holes (Continued)

Part 1.--Allegany County, N. Y. (Continued)

Well number	Owner or user	Year completed	Type of well	Depth of well (feet)	Diameter (inches)	Depth of casing (feet)	Depth to bedrock (feet)	Water-bearing material or unit	Altitude of land surface above sea level (feet)	Yield (gallons per minute)	Use	Analysis in appendix	Driller's log
212-807-4	Friendship Dairies, Inc. (former Gilt Edge Cheese site)	1946	drilled	--	8	--	--	Upper shale - sandstone	1500	r 95	U	--	--
212-808-1	S. A. Williams; village test hole T-1	1948	drilled	107	10,8	76	--	Sand and gravel	1540	--	Y	--	yes
-2	R. K. Shelly; village test hole T-2	1948	drilled	248	10,6	176	185	do.	1520	--	Y	--	yes
-3	Town of Friendship; village test hole T-3	1948	drilled	240	10,6	146	124	do.	1505	--	Y	--	yes
-4	L. Beardsley; village test hole T-4	1948	drilled	260	10,8	118	118	do.	1550	--	Y	--	yes
-5	Drake Manufacturing Co.	1964	drilled	130	6	127	--	do.	1535	r 60	I	--	--
212-809-2	Howard Tuttle	1965	drilled	62	6	60	--	do.	1560	r >5	D	--	yes
213-801-1	Leo Hunt, Belmont; village test hole T-1	1943	drilled	252	10,6	247	a252	do.	1420	--	Y	--	yes
-2	Lewellyn Casterline; village test hole T-4	1943	drilled	263	10,6	257	a263	do.	1390	--	Y	--	yes
213-802-1	Village of Belmont (former Borden Co. site)	a1920	drilled	a120	8	--	--	Sand and gravel	1360	r 50	U	--	--
-2	do.	a1920	drilled	a100	8	--	--	do.	1360	r 50	U	--	--
-3	do.	a1920	drilled	a 90	8	90	--	do.	1360	r 50	U	--	--
-4	Clayton Hanchett; village test hole T-2	1943	drilled	202	10,8	151	151	do.	1370	--	Y	--	yes
214-802-1	Village of Belmont well P-1, near test hole T-3	1943	drilled	149 2/ (208)	12,6	138 2/ (187)	-- 2/ (187)	do.	1380	r 80	P	c,s	yes
-2	do. well P-2 (north well)	1943	drilled	167	10,6	161	--	do.	1380	r 100	P	c,s	--
-3	do. well P-3 ("river well")	1954	drilled	24	12,6	11	--	do.	1350	r 110	P,Z	c,s	yes
215-758-1	do.	1939	drilled	301	8	134	208	Sand and gravel, and upper shale - sandstone	1620	r 46	Y	--	yes
217-758-1	Allegany County Home	1910	drilled	137	6	131	131	Upper shale - sandstone	1505	r 60	N	--	--
218-809-1	C. W. Chapman, Rockville	1963	drilled	32	6	32	--	Sand and gravel	1450	--	D	c	--
220-806-1	Village of Belfast "valley well" (near test well 3)	1962	drilled	145	14,6	142	--	do.	1275	r 100	P	c,s	yes
220-807-1	do. "terrace well"	1956	drilled	132	8	80	64	Upper shale - sandstone	1345	r 50	P,Z	c,s	yes
220-808-1	do. "hill well"	b1938	drilled	298	6	a 10	a 10	do.	1495	m 25	P,Z	c,s	--
225-809-1	Houghton College	1942	drilled	234	10,6	223	--	Sand and gravel	1260	r 300	N,P	c,s	yes
-2	Breyer Ice Cream Co.	b1930	drilled	108	8	100	--	do.	1210	r 150	U	--	--
227-746-1	Village of Canaseraga	b1936	drilled	a 30	6	--	--	do.	1260	r 250	P,Z	c,s	--
227-806-1	Village of Fillmore	1954	drilled	135	12	127	--	do.	1175	m 100	P	c,s	yes
-3	G. M. Cook	1953	drilled	130	6	127	--	do.	1170	r 18	P	c	--

2/ These data apply to test hole T-3 (later destroyed), at about the same site as well P-1.

Table A-1.--Records of selected wells and test holes (Continued)

Part 2.--Genesee County, N. Y.

Well number	Owner or user		Year completed	Type of well	Depth of well (feet)	Diameter (inches)	Depth of casing (feet)	Depth to bedrock (feet)	Water-bearing material or unit	Altitude of land surface above sea level (feet)	Yield (gallons per minute)	Use	Analysis in appendix	Driller's log
252-801-1	Village of Pavilion		1937	drilled	35	12,6	25	--	Sand and gravel	935	e 50	P	c,s	yes
-2	do.	hole T-2	1955	drilled	54	8	54	53	do.	938	--	T,Y	--	yes
-3	do.	hole T-3	1955	drilled	50	8,6	41	48	do.	935	r 20	T,Y	--	yes
-4	do.	hole T-4	1955	drilled	32	8	31	31	do.	935	r 7	T,Y	--	yes
-5	do.	hole T-5	1955	drilled	69	8	62	62	do.	938	r 30	T,Y	--	yes
-6	do.	hole T-6	1956	drilled	44	8,6	44	44	do.	940	r 8	T,Y	--	yes
-7	do.	hole T-7	1956	drilled	44	8	44	44	do.	945	--	T,Y	--	yes
-8	do.	hole T-8	1956	drilled	33	8	32	32	do.	938	--	T,Y	--	yes
-9	do.	hole T-9	1956	drilled	22	8	22	--	do.	938	--	T,Y	--	yes
-10	do.	hole T-10	1957	drilled	35	8	23	--	do.	940	--	T,Y	--	yes
-11	do.	hole T-11	1957	drilled	87	8,6	49	49	Sand and gravel, and upper shale - sandstone	960	r >3	T,Y	--	yes
-12	do.	hole T-1	1955	drilled	53	8	51	51	Sand and gravel	935	--	T,Y	--	yes
253-801-2	do.	hole T-12	1957	drilled	45	8	34	44	do.	930	--	--	--	yes
253-803-2	Benjamin Powell		1950	drilled	m 42	10	30	3	Upper shale - sandstone	1097	r 1	D	c	--
254-801-3	Rollin MacDuffie		a1963	drilled	55	6	55	--	Sand and gravel	930	r >15	D	c	--
255-801-1	Alton Wilson		1965	dug, drilled	125	36,6	--	--	Upper shale - sandstone	980	r 1	D	c	--
255-802-1	T. E. Parmenter		1963	drilled	53	6	53	--	Sand and gravel	944	r >30	D,S	c	--
255-803-1	Paul Rigoni		--	dug	m 21	36	--	--	Till	1030	--	D	--	--
256-759-1	William Yahn		1964	drilled	65	6	21	--	Upper shale - sandstone	955	r 2	D	c	--
256-805-1	George Conlber		1965	drilled	25	6	15	9	Upper shale - sandstone	954	r 16	D	c	--
257-756-1	John Bateman		1965	drilled	m 49	6	--	--	do.	883	r 30	D,S	c	--
257-757-1	Daton Scott		1965	drilled	m 43	--	--	--	do.	908	r >20	D	c	--
257-804-1	Richard Bausch		1965	drilled	a102	6	a102	--	Sand and gravel	918	r 16	D	c	--
258-757-1	Elm Dairy, LeRoy		1947	drilled	215	8	a 85	--	Limestone - dolomite	812	r 50	I	c,s	--
258-759-1	Western New York Refrigerating Corp.		--	drilled	212	8	--	--	do.	865	--	O	--	--
258-803-1	Glen Mulcahy		1961	drilled	a 40	6	--	--	do.	928	e <10	D	c	--
258-804-1	Carl Haynes		a1962	drilled	60	6	--	<15	do.	911	e <10	D	c	--
-2	Rex Zillman		1963	drilled	m104	6	a104	--	do.	920	r 40	D	c	--
258-809-1	O-AT-KA Milk Products Coop., Inc., Batavia		1958	drilled	49	18,10	41	--	Sand and gravel	903	r 400	I	--	yes

Table A-1.--Records of selected wells and test holes (Continued)

Part 2.--Genesee County, N. Y. (Continued)

Well number	Owner or user	Year completed	Type of well	Depth of well (feet)	Diameter (inches)	Depth of casing (feet)	Depth to bedrock (feet)	Water-bearing material or unit	Altitude of land surface above sea level (feet)	Yield (gallons per minute)	Use	Analysis in appendix	Driller's log
258-809-2	O-AT-KA Milk Products Coop., Inc., Batavia	1958	drilled	a 50	8	--	--	Sand and gravel	903	r 150	I	--	--
259-758-2	Curtice-Burns, Inc., LeRoy	a1960	drilled	300	8	--	--	Limestone - dolomite	860	r 70	I	c,s	--
259-759-1	Jello Div., General Foods Corp.	1941	drilled	225	8	28	28	do.	860	r 160	U	c	yes
259-809-1	O-AT-KA Milk Products Coop., Inc., Batavia	1963	drilled	60	20,16	40	--	Sand and gravel	890	r 1200	I	c	yes
-2	City of Batavia well 1 or A	1963	drilled	69	16	57	--	do.	895	r 1000	P	c	yes
-3	do. test well 14	1962	drilled	m 54	8	51	--	do.	895	r 235	T,O	--	yes
-5	do. test well 12	1962	drilled	70	8	60	--	do.	890	r 245	T,U	--	yes
-6	do. well 2 or B	1963	drilled	80	--	--	--	do.	895	r 1007	P	--	yes
-7	do. test well 8	1963	drilled	60	8	--	--	do.	890	r 200	T,Y	--	yes
-8	do. test well 9	1962	drilled	42	8	a 41	--	do.	900	--	T,Y	--	yes
300-757-1	L. J. Muehlig	1964	drilled	43	6	--	--	Gypsum - shale	630	r 22	D	c	--
300-758-1	Louis Crocker	1960	drilled	144	6	12	12	Limestone - dolomite and gypsum - shale	808	e <20	D	c	--
300-800-1	Harry Kanner	1957	drilled	99	6	--	3	do.	848	e 10	D,S	c	--
301-754-1	N. Y. State Thruway, Ontario Service Area	1953	drilled	40	6	--	5	Gypsum - shale	640	r 40	T,Y	--	--
-2	do.	1953	drilled	105	6	--	37	do.	670	r 90	C	c,s	--
-3	Dean Sehm	1963	drilled	44	6	--	--	Sand and gravel	675	e <40	D	c	--
-4	Laverne Thompson	--	drilled	a 35	6	a 35	--	do.	671	--	D	c	--
303-803-1	Robert Eichberger	1955	drilled	112	6	112	--	do.	660	--	D	c	--
303-807-1	Dave Walters	--	driven	--	1 1/4	--	--	do.	725	--	D	c	--
304-756-1	Village of Bergen	1939	dug, drilled	46	72,8	46	20	Gypsum - shale	625	e 350	P	c,s	--
304-800-1	E. W. Redinger	1955	drilled	22	6	--	--	do.	687	r <30	D	c	--
-2	Byron-Bergen Central School	1955	drilled	63	8	58	20	do.	675	r 40	N	c	--
305-756-1	Curtice-Burns, Inc., Bergen well 1	b1950	drilled	a 50	18,8	--	--	Sand and gravel	610	e 250	I	c	--
-2	do. well 2	1950	drilled	30	24,12	--	20	Sand and gravel, or gypsum - shale	600	r 250	I	c,s	--
-3	Guy Burr	1965	drilled	50	6	--	--	Gypsum - shale	599	e 30	D	c	--
305-804-1	Kenneth Perkins	1961	drilled	25	6	16	16	Dolomite - shale	648	r 30	D	c	--
306-755-1	James Quinn	1960	drilled	45	6	--	--	do.	592	e <30	D	c	--
307-802-1	Alan Ferguson	1960	drilled	65	6	--	--	do.	651	e 10	D	c	--
307-803-1	Lester Johnson	1964	drilled	35	6	--	--	do.	638	r 8	D	c	--

Table A-1.--Records of selected wells and test holes (Continued)

Part 3.--Livingston County, N. Y.

Well number	Owner or user	Year completed	Type of well	Depth of well (feet)	Diameter (inches)	Depth of casing (feet)	Depth to bedrock (feet)	Water-bearing material or unit	Altitude of land surface above sea level (feet)	Yield (gallons per minute)	Use	Analysis in appendix	Driller's log
232-739-1	Village of Dansville hole 9	1946	drilled	59	6	--	53	Sand and gravel	1040	--	T,Y	--	yes
232-741-1	do. hole 11	1946	drilled	112	6	--	112	do.	720	--	T,Y	--	yes
232-742-1	do. hole 6	1946	drilled	84	6	--	78	do.	687	--	T,Y	--	yes
-2	do. hole 10	1946	drilled	123	6	--	123	do.	700	--	T,Y	--	yes
233-741-1	do. hole 2	1946	drilled	100	6	--	92	do.	690	--	T,Y	--	yes
233-742-1	do. hole 4	1946	drilled	148	6	--	--	do.	670	--	T,Y	--	yes
-2	do. hole 5	1946	drilled	154	6	--	--	do.	645	--	T,Y	--	yes
-3	do. hole 8	1946	drilled	222	6	--	216	do.	690	--	T,Y	--	yes
234-742-1	do. hole 17	1946	drilled	276	6	--	268	do.	660	--	T,Y	--	yes
234-743-1	do. hole 12	1946	drilled	122	6	--	--	do.	630	--	T,Y	--	yes
-2	do. hole 13	1946	drilled	56	6	--	--	do.	628	--	T,Y	--	yes
-3	do. hole 14	1946	drilled	57	6	--	--	do.	632	--	T,Y	--	yes
-4	do. hole 15	1946	drilled	32	6	--	32	do.	621	--	T,Y	--	yes
-5	do. hole 16	1946	drilled	54	6	--	--	do.	610	--	T,Y	--	yes
234-757-1	Ben Cromwell	1948	drilled	92	6	92	--	do.	975	r120;e20f	D,S	--	--
234-802-1	Mary Oulton	1958	drilled	63	6	63	--	do.	1330	r 60	D	--	--
235-743-1	Frank McNair	1924	drilled	450	8	--	--	do.	595	--	A	c,s	--
236-743-1	Daisy Everman	1965	drilled	55	6	55	--	do.	615	r 60	U	--	--
237-735-1	Stuart May	1965	drilled	30	6	30	--	Sand	1025	e 15	D	c	--
239-746-2	Dairymen's League Coop., Inc., Groveland	1951	drilled	60	6	a 60	--	Sand and gravel	595	r 30	I,Z	c,s	--
240-737-1	Conesus Milk Producers Coop. Assn., Webster Crossing	1940	drilled	110	6	79	98	do.	1333	r 25	Y	--	yes
240-738-2	do.	a1940	drilled	a 65	10	--	--	do.	1340	m 30	I	c,s	--
-3	do.	1940	drilled	150	6	--	98	Upper shale - sandstone	1352	r 8	Y	--	yes
241-749-1	Craig Colony and Hospital, Sonyea well 2	b1935	dug	m 23	144	--	--	Alluvium	570	--	N	c,s	--
-2	do. well 1	--	dug	m 18	120	--	98	do.	580	--	N	c,s	--
242-753-1	Anthony Conte	1962	drilled	m 26	6	a 15	a 15	Upper shale - sandstone	850	r 64	D	--	--
242-756-1	Lewis Patrick	a1890	drilled	210	4	210	--	Sand and gravel	923	r 40	D,S	--	--
243-749-1	Samuel Sanderson	1954	drilled	54	6	51	--	Upper shale - sandstone	610	r 30	D	--	--

Table A-1.--Records of selected wells and test holes (Continued)

Part 3.--Livingston County, N. Y. (Continued)

Well number	Owner or user	Year completed	Type of well	Depth of well (feet)	Diameter (inches)	Depth of casing (feet)	Depth to bedrock (feet)	Water-bearing material or unit	Altitude of land surface above sea level (feet)	Yield (gallons per minute)	Use	Analysis in appendix	Driller's log
243-752-1	Curtice-Burns, Inc., Mount Morris [3]	1938	drilled	329	12,8	291	--	Sand and gravel	575	r 350	U	--	--
-2	J. J. Zaso [3]	1938	drilled	107	12,8	94	--	do.	575	r 150	U	--	--
-3	Genesee Valley Cold Storage Co. [3]	1947	drilled	24	30,12	19	--	do.	575	r 310	U	--	yes
-4	Curtice-Burns, Inc. [3]	1947	drilled	28	30,12	23	--	do.	575	r 440	U	--	yes
244-750-1	Village of Mount Morris hole T-1	1947	drilled	50	8	44	--	do.	565	--	T,Y	--	yes
-2	do. hole T-2	1947	drilled	41	8	29	--	do.	570	r 60	T,Y	--	yes
-3	do. hole T-3	1947	drilled	40	8	22	--	do.	570	r 150	T,Y	--	yes
244-752-1	Curtice-Burns, Inc., north of Mount Morris well P-2	1942	drilled	33	18,8	24	--	do.	580	r 120	U	--	yes
-2	do. well P-1	1942	drilled	47	18,8	25	--	do.	580	r 75	U	--	yes
-3	do. hole 1	1965	drilled	80	7	--	--	do.	470	--	T,Y	--	yes
-4	do. hole 2	1965	drilled	50	7	--	--	Sand and gravel	470	r 20	T,Y	--	yes
246-751-1	Barratt Morris	a1961	drilled	33	6	33	--	Alluvium	572	e 20	D	c	--
246-753-2	Andrea Muscarella	1947	drilled	99	6	99	--	Sand and gravel	655	r 40	D,S	--	--
247-748-1 [4]	Maude Redmond, Geneseo	--	dug	28	48	--	--	Till	795	--	D	--	--
249-736-1	Charles Rolfe	a1962	drilled	42	8	42	--	Sand and gravel	1065	r 65	S	--	--
249-738-2	Charles Hill	1964	drilled	179	8	116	--	do.	1085	r 50	D	--	--
249-740-1	Livonia Dairy, Inc.	a1954	drilled	a170	8	--	--	do.	970	e 20	I	c,s	--
250-753-2	International Salt Co., Retsof	1959	drilled	59	10,8	52	52	do.	720	r 60	T,Y	--	yes
253-736-1	Joseph Cutbertson	1964	drilled	75	6	75	--	do.	878	e <10	D	c	--
253-738-2	L. J. Wickum	1959	drilled	85	6	60	60	Upper shale - sandstone	970	e 10	D	c	--
253-747-1	Paul Croston	1963	drilled	120	6	120	--	Sand	565	e >15	D	c	--
253-757-1	Dorr Roberts	1955	drilled	78	6	78	--	Upper shale - sandstone	935	e >10	D	c	--
254-734-2	Gerald Martin, east of Lima test well 1 [5]	1964	drilled	110	6	--	110	Sand and gravel	860	--	T	--	yes
-3	do. test well 2 [5]	1964	drilled	133	6	--	133	do.	870	--	T	--	yes
-4	do. test well 3 [5]	1964	drilled	101	6	--	101	do.	840	r 25	T	--	yes
254-738-1	Village of Lima, west of Lima	1889	dug	26	144	--	--	do.	890	r 100	D,Z	--	--
-2	do.	1960	drilled	42	24,12	32	--	do.	885	r 370	P	c,s	yes

3/ Former site of General Foods Corp., Birds Eye Division, for whom the four wells were drilled.
4/ Well is identified as "Lv 1" in published reports of water-level observations.
5/ Drilled for Vogt Manufacturing Co.

Table A-1.--Records of selected wells and test holes (Continued)

Part 3.--Livingston County, N. Y. (Continued)

Well number	Owner or user	Year completed	Type of well	Depth of well (feet)	Diameter (inches)	Depth of casing (feet)	Depth to bedrock (feet)	Water-bearing material or unit	Altitude of land surface above sea level (feet)	Yield (gallons per minute)	Use	Analysis in appendix	Driller's log
254-745-1	General Foods Corp., Avon Plant test well 1	1945	drilled	43	6	--	30	Sand and gravel	580	--	T,Y	--	yes
256-735-1	Donald Hofman	1961	drilled	105	6	--	--	Limestone - dolomite	698	--	D	c	--
257-749-1	Robert Brown	1949	drilled	55	6	55	--	Sand and gravel	679	--	D	c	--
-2	Eugene Wyand	--	drilled	56	6	56	--	do.	675	e 20	D,S	c	--
257-751-1	Claude Campbell	1957	drilled	36	6	36	30	Limestone - dolomite	695	r 4	D	c	--
258-746-1	James Leathersich	1958	drilled	52	6	52	--	Sand and gravel	621	r >15	D	c	--
258-749-1	Ken Zimmer	1963	drilled	68	6	68	--	do.	662	r >10	D	c	--
258-750-2	Jones Chemicals, Inc. Caledonia	1959	drilled	48	6	45	--	Limestone - dolomite	650	r 40	I	c,s	--
-4	Village of Caledonia	1896	dug	17	168	15	--	Sand and gravel	645	r 500	P	--	--
-5	do.	1954	drilled	50	18,10	21	46	do.	645	r 350	P	c,s	yes
-6	do.	1964	drilled	26	24,18	16	--	do.	640	r 550	P	c	yes

Table A-1.--Records of selected wells and test holes (Continued)

Note: The location of wells listed below and on the next two pages are not plotted on plate 1; however, accurate locations are given below by latitude and longitude.

Part 4a.--Some of the wells listed in the Monroe County report (by Leggette and others, 1935)

Well number	Location		Type of well	Depth of well (feet)	Diameter (inches)	Depth to bedrock (feet)	Water-bearing material or Unit	Altitude of land surface above sea level (feet)	Use	Analysis in appendix
	North latitude	West longitude								
256-733-1	42°56'59"	77°33'13"	dug	85	36	65	Limestone - dolomite	715	S	6/
256-742-1	42°56'35"	77°42'18"	drilled	110	6	1	do.	680	D	6/
256-743-1	42°56'59"	77°43'19"	dug	30	42	--	Unconsolidated deposit	580	D	6/
257-739-2	42°57'45"	77°39'44"	drilled	60	6	--	Limestone - dolomite	615	D	6/
257-741-1	42°57'19"	77°41'31"	drilled	60	--	--	do.	625	D	6/
257-742-1	42°57'57"	77°42'34"	drilled	110	6	--	Quicksand	605	S	6/
258-734-2	42°58'12"	77°34'01"	dug	32	36	--	Sand and clay	650	D	6/
258-737-1	42°58'30"	77°37'06"	drilled	75	6	40	Limestone - dolomite	635	D	6/
258-739-1	42°58'05"	77°39'09"	drilled	85	6	--	Gravel	610	D	6/
-2	42°58'48"	77°39'14"	drilled	1600	10	--	Gypsum - shale and dolomite	555	U	6/
258-740-2	42°58'19"	77°40'10"	dug	30	48	--	Unconsolidated deposit	680	D	6/
258-741-1	42°58'37"	77°41'26"	dug	23	42	--	do.	590	D	6/
259-735-1	42°59'04"	77°35'12"	drilled	60	6	--	Gravel	635	D	6/
259-736-1	42°59'36"	77°36'26"	dug	25	36	--	Sand	630	D	6/
259-737-1	42°59'22"	77°37'57"	drilled	108	6	--	Clay	615	D	6/
259-738-1	42°59'28"	77°38'42"	drilled	100	6	--	Sand	575	D	6/
259-740-1	42°59'49"	77°40'07"	drilled	103	6	103	Gypsum - shale	620	D	6/
259-746-1	42°59'22"	77°46'06"	dug	21	36	--	Gravel	635	D	6
259-753-1	42°59'31"	77°53'49"	drilled	75	6	2	Limestone - dolomite	745	D	6/
300-735-1	43°00'36"	77°35'25"	drilled	95	6	--	Gypsum - shale	615	D	6/
300-753-1	43°00'15"	77°53'00"	dug	22	42	--	Unconsolidated deposit	625	D	6/
301-740-1	43°01'46"	77°40'04"	dug	25	36	--	do.	650	D	6/
301-742-2	43°01'45"	77°42'53"	drilled	42	6	22	Gypsum - shale	560	D	6/
-3	43°01'29"	77°42'22"	drilled	70	6	--	Quicksand	575	S	6/
301-746-1	43°01'35"	77°46'32"	drilled	49	6	--	Gypsum - shale	600	D	6/
301-750-1	43°01'06"	77°50'02"	drilled	90	6	--	do.	645	S	6/
301-752-1	43°01'48"	77°52'48"	drilled	55	6	30	Limestone - dolomite	660	D	6/
302-735-1	43°02'29"	77°35'19"	dug	44	30	--	Sand	685	D	6/

6/ Chemical analysis made in 1934 or 1935.

Table A-1.--Records of selected wells and test holes (Continued)

Part 4a.--Some of the wells listed in the Monroe County report (by Leggette and others, 1935). (Continued)

Well number	Location		Type of well	Depth of well (feet)	Diameter (inches)	Depth to bedrock (feet)	Water-bearing material or unit	Altitude of land surface above sea level (feet)	Use	Analysis in appendix
	North latitude	West longitude								
302-737-1	43°02'26"	77°37'32"	drilled	50	6	--	Quicksand	635	D	6/
302-740-1	43°02'07"	77°40'35"	dug	45	48	--	Gravel	655	D	6/
302-751-1	43°02'39"	77°51'34"	drilled	70	6	--	Gypsum - shale	665	D	6/
303-739-1	43°03'40"	77°39'04"	drilled	175	8	--	do.	615	S	6/
303-741-1	43°03'53"	77°41'21"	drilled	98	6	--	Unconsolidated deposit	580	D	6/
303-748-1	43°03'32"	77°48'45"	dug	16	48	--	do.	600	D	6/
303-755-1	43°03'23"	77°55'54"	drilled	38	--	25	Gypsum - shale	675	D	6/
304-738-4	43°04'31"	77°38'37"	dug	22	36	--	Sand	525	D	6/
304-740-1	43°04'20"	77°40'54"	dug	35	60	--	Unconsolidated deposit	535	D	6/
304-746-1	43°04'19"	77°46'02"	drilled	50	6	20	Gypsum - shale	550	D	6/
304-751-1	43°04'27"	77°51'35"	dug	22	36	--	do.	585	D	6/
304-753-1	43°04'08"	77°53'09"	dug	48	--	--	Unconsolidated deposit	640	D	6/
304-755-1	43°04'59"	77°55'15"	dug	40	48	--	do.	610	D	6/
305-737-1	43°05'39"	77°37'59"	drilled	90	6	70	Gypsum - shale	536	D	6/
305-739-1	43°05'18"	77°39'21"	drilled	65	6	--	Sand	530	D	6/
305-746-1	43°05'47"	77°46'43"	dug	33	42	--	Unconsolidated deposit	565	D	6/
305-749-1	43°05'16"	77°49'13"	dug	25	48	--	Clay	585	D	6/
305-753-1	43°05'13"	77°53'07"	drilled	60	6	28	Dolomite	595	D	6/
-2	43°05'15"	77°53'37"	dug	45	42	--	Gravel	585	D	6/
306-740-1	43°06'45"	77°40'47"	drilled	35	6	--	do.	535	D	6/
306-743-1	43°06'51"	77°43'56"	drilled	42	6	--	Dolomite	575	D	6/
306-749-1	43°06'31"	77°49'09"	drilled	62	6	58	do.	590	D	6/
306-751-1	43°06'42"	77°51'29"	dug	20	36	--	Gravel	615	S	6/
306-754-1	43°06'51"	77°54'43"	drilled	55	6	--	Dolomite	585	D	6/
307-743-1	43°07'32"	77°43'36"	dug	35	72	--	Gravel	580	D	6/
307-748-1	43°07'39"	77°48'36"	drilled	27	6	--	Dolomite	600	D	6/
307-752-1	43°07'26"	77°52'57"	drilled	40	6	20	do.	600	D	6/
307-759-1	43°07'59"	77°59'08"	drilled	40	6	25	do.	635	D	6/
308-744-1	43°08'29"	77°44'32"	drilled	60	6	12	do.	575	D	6/
-2	43°08'30"	77°44'40"	drilled	35	4	12	do.	570	I	6/

6/ Chemical analysis made in 1934 or 1935.

Table A-1.--Records of selected wells and test holes (Continued)

Part 4a.--Some of the wells listed in the Monroe County report (by Leggette and others, 1935). (Continued)

Well number	Location: North latitude	Location: West longitude	Type of well	Depth of well (feet)	Diameter (inches)	Depth to bedrock (feet)	Water-bearing material or unit	Altitude of land surface above sea level (feet)	Use	Analysis in appendix
308-745-1	43°08'16"	77°45'28"	drilled	30	6	--	Dolomite	575	D	6/
309-743-1	43°09'34"	77°43'58"	drilled	35	6	3	do.	580	D	6/
309-745-1	43°09'19"	77°45'19"	drilled	26	6	7	do.	580	D	6/
309-753-1	43°09'07"	77°53'33"	drilled	39	6	--	do.	645	D	6/
309-758-1	43°09'02"	77°58'29"	drilled	60	6	--	do.	650	D	6/

6/ Chemical analyses made in 1934 or 1935.

Table A-1.--Records of selected wells and test holes (Continued)

Part 4b.--Monroe County, N. Y. (unpublished data)

Well number	Owner or user	Year completed	Type of well	Depth of well (feet)	Diameter (inches)	Depth of casing (feet)	Depth to bedrock (feet)	Water-bearing material or unit	Altitude of land surface above sea level (feet)	Yield (gallons per minute)	Use	Analysis in appendix	Driller's log
257-735-1	Village of Honeoye Falls	a1913	drilled	a 105	12	--	--	Limestone - dolomite	665	r 300	P,Z	--	--
-2	do.	a1914	drilled	a 105	12	--	--	do.	665	r 345	P,Z	c,s	--
258-734-1	James Boillat	1964	drilled	100	6	90	90	do.	645	r 16	D	c	--
259-734-1	John Laraway	1959	drilled	135	6	135	135	Gypsum - shale	680	r 3	D	--	--
300-737-1	City of Rochester test well 1	1941	drilled	633	8	368	503	Sand and gravel	599	r 135	U	--	yes
-2	do. test well 2	1942	drilled	486	8	151	416	do.	596	r 75	U	--	yes
300-746-1	Village of Scottsville	a1952	drilled	29	--	--	--	Gypsum - shale	570	--	P,Z	c,s	--
301-742-1	Albert Schendel	b1935	dug	m 13	36	--	--	Sand	568	e 1	D	c	--
302-742-1	Marjorie Diver	1960	drilled	76	6	50	50	Gypsum - shale	566	r 25	D	c	--
302-743-2	N.Y.State Thruway, Scottsville Service Area	1953	drilled	115	6	--	115	Gravel	525	20	Y	--	--
306-752-1	Village of Churchville	1957	drilled	115	--	--	--	Dolomite	595	r 150	P	c	--
307-736-1	Rochester State Hospital	1893	drilled	59	10	--	--	do.	525	r 117	N	--	--
-2	do.	1893	drilled	a 65	--	--	--	do.	525	r 117	N	--	--
307-737-1	University of Rochester, Cyclotron Bldg.	1947	drilled	66	8	37	37	do.	534	r 50	I	--	--
308-739-1	General Railway Signal Co. test hole T-1	1947	drilled	27	8	26	--	Sand and gravel	540	--	Y	--	yes
-2	do. test hole T-2	1947	drilled	115	8	23	21	Dolomite	540	r 45	Y	--	yes
-3	do. test hole T-3	1947	drilled	60	8	34	34	do.	540	r <10	Y	--	yes
-4	do. test hole T-4	1947	drilled	107	8	20	20	do.	540	r <15	Y	--	yes
308-739-7	Town of Gates ("Gates well")	a1866	drilled	a 150	6	20	20	Dolomite	538	r 450	Y	--	--
-8	do. test hole T-1	1950	drilled	173	8	17	16	do.	535	r 190	Y	--	yes
-9	do. test hole T-2	1950	drilled	55	8	23	23	do.	535	r 85	Y	--	yes
-10	do. test hole T-3	1950	drilled	55	8	23	23	do.	535	r 85	Y	--	yes
-11	do. test hole T-4	1951	drilled	60	10	23	23	do.	538	r 500	Y	--	yes
308-740-1	Pfandler Co.	a1903	drilled	60	7	50	--	do.	542	r 100	U	--	--
-2	do.	1937	drilled	80	7	70	--	do.	542	r 100	I	--	--

Table A-1.--Records of selected wells and test holes (Continued)

Part 5.--Ontario County, N. Y.

Well number	Owner or user	Year completed	Type of well	Depth of well (feet)	Diameter (inches)	Depth of casing (feet)	Depth to bedrock (feet)	Water-bearing material or unit	Altitude of land surface above sea level (feet)	Yield (gallons per minute)	Use	Analysis appendix	Driller's log
247-730-1	Village of Honeoye well 1	1953	drilled	42	12,8	36	--	Sand and gravel	810	100	P	c,s	yes
-2	do. well 2	1962	drilled	51	18,12	41	--	do.	810	r 300	P	--	yes
-3	Di-Noc Chemical Arts, Inc.	a1960	drilled	103	--	--	--	do.	850	r 1500	I,Z	--	--
-4	do.	1960	drilled	91	20	--	--	do.	850	r 800	I	c	yes
252-727-1	Carl Bacus	1952	drilled	110	6	--	--	Till	1030	r 3	D	c	--
252-731-1	David Good	1962	drilled	71	6	71	--	Sand and gravel	875	e 30	D	c	--
254-733-2	Jack Palmer	1947	drilled	117	7	117	--	do.	860	r 15	C,D	c	yes

Table A-1.--Records of selected wells and test holes (Continued)

Part 6.--Steuben County, N. Y.

Well number	Owner or user	Year completed	Type of well	Depth of well (feet)	Diameter (inches)	Depth of casing (feet)	Depth to bedrock (feet)	Water-bearing material or unit	Altitude of land surface above sea level (feet)	Yield (gallons per minute)	Use	Analysis in appendix	Driller's log
208-744-1	Bradley Producing Corp., Hunt Well W-1	1951	drilled	300	10	38	36	Upper shale - sandstone	1935	r 96	I	--	yes
-2	do. Hunt well	1956	drilled	300	10	45	38	do.	1935	--	I	--	yes
228-740-1	Robert Imboden	1965	drilled	a 86	6	86	--	Sand	1390	mlf	D	c	--
230-740-1	James Acomb	1964	drilled	155	6	65	--	Sand and gravel	1260	r 10	D	--	yes
230-741-1	Stony Brook State Park, Dansville	1964	drilled	91	8	28	19	Upper shale - sandstone	1262	e 35	C	--	yes
230-742-1	Joseph Mattle	1962	drilled	140	6	140	--	Sand and gravel	1122	r 25	D	--	--
232-737-4	Village of Dansville, Perkinsville (west well)	1964	drilled	106	24,18	--	--	do.	1360	700	P	--	yes
-5	do. (east well)	1964	drilled	72	24,18	--	--	do.	1360	700	P	--	yes
-6	F. M. S. & Swell, Inc.	a1948	drilled	38	8,6	--	--	do.	1340	r 200	I	c,s	--
233-734-1	Village of Wayland hole T-2	1954	drilled	34	10,6	29	--	do.	1365	r 35	T	--	yes
-2	do. hole T-3	1954	drilled	54	10	46	--	do.	1370	--	T	--	yes
-3	do. hole T-4	1955	drilled	39	10,6	34	--	do.	1370	r 60	T	--	yes
233-735-1	W. H. Gunlocke Chair Co., (northeast well)	1961	drilled	49	24,18	25	--	do.	1365	r 1500	I,Z	--	yes
-2	do. (southwest well)	b1951	drilled	80	5	40	--	--	1365	r 75	I	c,s	yes
-3	Village of Wayland hole T-2. 1947	1947	drilled	42	10,4	36	--	Sand and gravel	1375	r 100	T	--	yes
-4	do. well P-2	1956	drilled	45	18,12	35	--	do.	1375	r 700	P	--	--
-5	do. hole T-6	1956	drilled	65	8	58	--	do.	1375	--	T	--	yes
-6	do. hole T-7	1956	drilled	41	8,6	36	--	do.	1368	r 150	T	--	yes
-7	do. hole T-1	1954	drilled	75	10	62	--	do.	1365	--	T	--	yes
234-735-2	General Foods Corp., Birds Eye Division, Wayland	a1900	drilled	m 41	5	--	--	do.	1380	r 60	U	c,s	--
-3	do.	1947	drilled	38	30,18	28	--	do.	1380	r 60	U	--	yes
-4	Village of Wayland, well P-1	1947	drilled	59	18,10	49	--	do.	1380	r 700	P	c,s	--
-5	do hole T-5	1955	drilled	62	8	51	50	Upper shale - sandstone	1420	--	T	--	yes

Table A-1.--Records of selected wells and test holes (Continued)

Part 7.--Wyoming County, N. Y.

Well number	Owner or user	Year completed	Type of well	Depth of well (feet)	Diameter (inches)	Depth of casing (feet)	Depth to bedrock (feet)	Water-bearing material or unit	Altitude of land surface above sea level (feet)	Yield (gallons per minute)	Use	Analysis in appendix	Driller's log
232-803-1	American Bluestone Co., south of Portageville	1951	drilled	50	6	32	32	Upper shale - sandstone	1138	r 30	I	c	--
233-805-1	Walter Mehlenbacher	1962	drilled	170	6	170	--	Sand and gravel	1570	r 10	C,D	--	--
233-809-1	Village of Pike	1950	drilled	62	6	62	--	do.	1545	e 16	P	c,s	yes
234-815-1	Bliss Water Supply Co.	1961	drilled	34	6	34	--	do.	1719	r 65	P	c,s	--
236-804-1	Village of Castile, southwest of Castile	a1934	dug	m 8	48	--	--	Sand	1430	--	P	c,s	--
-2	do.	--	drilled	m 17	10	--	--	Sand and gravel	1460	m 60	P	c,s	--
-3	do.	--	drilled	m 16	10	--	--	do.	1460	--	O	--	--
-4	do.	a1937	drilled	a 20	10	--	--	do.	1520	--	P,Z	--	--
237-759-1 1/	Letchworth State Park, east of Castile	--	dug, driven	m 14	24,2	11	--	Till	1020	--	O	--	--
237-803-2	Village of Castile hole 3	1965	drilled	71	6	71	--	Sand and gravel	1395	--	T	--	yes
238-801-1	Lawrence Kelly	1958	drilled	203	4	203	--	do.	1390	e 15	D	--	--
238-802-2	Village of Castile hole 1	1965	drilled	225	6	225	--	do.	1375	--	T	--	yes
-3	do. hole 2	1965	drilled	85	6	85	--	do.	1380	--	T	--	yes
238-803-2	do. hole 4	1965	drilled	61	8	61	--	do.	1355	--	T	--	yes
239-804-2	Morton Salt Co., Silver Springs	1950	drilled	a 165	18,10	a150	--	do.	1370	r 185	U	--	yes
239-805-1	Village of Silver Springs (east well)	1958	drilled	242	8	164	161	Upper shale - sandstone	1530	e 100	P	c,s	yes
-2	do. (west well)	1958	drilled	91	--	--	--	Sand and gravel	1530	--	P	c,s	--
239-809-1	Lewis Bannister	--	driven	20	1 1/4	20	--	do.	1644	e 10	D	c	--
247-800-1	Sears Farm, Inc.	1961	drilled	122	6	116	114	Upper shale - sandstone	1275	r 4	D,S	--	--
249-804-1	Village of Wyoming	1945	drilled	88	12,8	--	--	Sand and gravel	955	e 30	P	c,s	--
-2	Curtice-Burns, Inc., Wyoming	a1935	drilled	368	10,6	125	--	Upper shale - sandstone	965	r 75	A	--	--
251-802-1	Village of Pavilion, south of Pavilion well P-1	a1959	drilled	32	12,8	22	--	Sand and gravel	940	e 100	P	c,s	yes
-2	do. hole T-13	1957	drilled	27	8,6	22	--	do.	938	--	T	--	yes
-3	do. hole T-14	1957	drilled	27	8,6	17	--	do.	937	--	T,Y	--	yes

1/ Well identified as "Wo 1" in published reports of water-level fluctuations in observation wells.

Table A-1.--Records of selected wells and test holes (Continued)

Part 8.--Potter County, Pa.

Well number	Owner or user	Year completed	Type of well	Depth of well (feet)	Diameter (inches)	Depth of casing (feet)	Depth to bedrock (feet)	Water-bearing material or unit	Altitude of land surface above sea level (feet)	Yield (gallons per minute)	Use	Analysis in appendix	Driller's log
154-745-1	Lewisville Water Co., Ulysses (southwest well)	b1935	drilled	126	6	30	--	Upper shale - sandstone	2090	r 40	P	c	--
-2	do. (northeast well)	1961	drilled	145	8	--	--	do.	2090	--	P	c	--
155-753-1	N. Y. State Natural Gas Corp., Ellisburg Station	1963	drilled	183	7	98	81	do.	1940	r 40	I	--	yes
-2	N. Y. State Natural Gas Corp., Hile-Ellis-Cobb farm 8/	1935	drilled	5039	10,7	5003	133	do.	1870	--	D	--	yes
159-752-1	N. Y. State Natural Gas Corp., Cabot Station	1937	drilled	59	10	35	--	Sand and gravel	1620	r 420	D	--	yes

8/ Gas-storage well, originally drilled for gas; fresh water between 134 and 522 feet, for several houses.

Table A2.--Drillers' logs of selected wells and test holes in the Genesee River basin

Part 1.--Allegany County, N. Y.

		Depth (feet) From	Depth (feet) To	Thickness (feet)
202-746-1:	Drilled by Howard Hinges			
	Topsoil	0	4	4
	Sand and gravel	4	47	43
	Clay	47	69	22
	Gravel and fine sand	69	84	15
	Pinkish clay	84	89	5
	Slate rock	89	105	16
	Sand; water-bearing	105	107	2
	Slate	107	133	26
	"Salt-and-pepper" sand; water-bearing	133	136	3
	Slate rock pocket	136	141	5
202-758-1:	Drilled by Howard Gale			
	Earth	0	14	14
	Gravel	14	18	4
	Earth	18	33	15
	Gravel	33	65	32
	Clay	65	72	7
	Brown shale	72	79	7
	Slate	79	90	11
	Slate and red rock; water enough to drill with (at 94 feet)	90	104	14
	Gray sand and red rock; more water	104	112	8
	Slate	112	115	3
	Gray sand	115	120	5
	Slate	120	144	24
	Clover seed; more water	144	149	5
	(No record)	149	184	35
	Soft lime	184	192	8
	Red rock	192	196	4
	Slate	196	216	20
	Soft gray sand; more water	216	230	14
	Soft lime	230	246	16
	Clover seed	246	252	6
	Bright red rock	252	257	5
	Soft lime	257	272	15
	Gray sand	272	273	1
	Dark red rock	273	282	9
	Dark lime	282	286	4
	Brown sand	286	287	1
	Soft lime	287	296	9
	Red rock	296	308	12
202-758-2:	Drilled by Howard Gale			
	Earth	0	14	14
	Gravel	14	19	5
	Brown clay	19	26	7
	Gravel	26	35	9
	Hardpan	35	58	23
	Gravel; water enough to drill with (at 70 to 80 feet; then cased off)	58	85	27
	Broken shale	85	93	8
	Red rock; water (15 gpm)	93	95	2
	Gray sand	95	98	3
	Broken lime	98	120	22
	Slate	120	131	11
	Soft lime	131	138	7
	Clover seed; water (20 gpm)	138	142	4
	Soft lime	142	185	43
	Slate	185	200	15
	Soft lime	200	205	5
	Lime and clover seed; water (bailed steady)	205	210	5
	Slate and shell	210	219	9
	Soft lime	219	224	5
	Brown lime	224	245	21
	Mixed clover seed	245	251	6
	Bright red rock	251	256	5
	Red rock and clover seed	256	263	7
	Soft lime	263	270	7
	Red rock	270	278	8
	Soft lime	278	296	18
	Red rock	296	305	9
	Slate	305	307	2
202-758-3:	Drilled by Howard Gale			
	Earth	0	10	10
	Gravel	10	17	7
	Clay	17	24	7
	Gravel	24	31	7
	Hardpan	31	60	29
	Gravel	60	85	25
	Shale	85	93	8
	Gray sand	93	97	4
	Slate	97	122	25
	Soft lime	122	135	13
	Clover seed	135	138	3
	Soft lime	138	182	44
	Slate	182	194	12
	Red rock	194	198	4
	Soft lime	198	205	7
	Hard slate	205	222	17
	Gray sand	222	227	5
	Brown lime	227	246	19
	Clover seed	246	253	7
	Red rock	253	260	7
	Soft lime	260	277	17
	Slate	277	297	20
	Red rock	297	304	7
	Slate	304	305	1

Part 1.--Allegany County, N. Y. (Cont'd.)

		Depth (feet) From	Depth (feet) To	Thickness (feet)
204-803-2:	Drilled by Howard Gale			
	Earth	0	9	9
	Gravel	9	16	7
	Hardpan	16	20	4
	Gravel	20	26	6
	Clay	26	28	2
	Soft slate; water (8 gpm at 30 feet)	28	36	8
	Soft red rock	36	38	2
	Gray sand	38	48	10
	Red rock	48	56	8
	Slate	56	58	2
	Brown rock	58	65	7
	Gray sand	65	72	7
	Slate (16 gpm at 77 feet)	72	100	28
	Lime shell	100	102	2
	Gray sand (12 gpm at 104 feet)	102	105	3
	Slate	105	111	6
	Red rock	111	116	5
	Lime shell	116	119	3
	Slate	119	147	28
	Lime and slate	147	158	11
	Soft slate	158	170	12
	Lime and slate	170	181	11
	Lime	181	195	14
	Slate and lime shell	195	220	25
	Lime	220	227	7
	Slate	227	229	2
	Lime	229	235	6
	Gray sand	235	238	3
	Clover seed sand (too much to bail at 240 feet)	238	246	8
	Lime and slate	246	253	7
	Broken sand	253	258	5
	Lime and slate	258	271	13
	Gray sand	271	274	3
	Lime and slate	274	300	26
205-755-2:	Drilled by H. F. Bunnell			
	Sand	0	32	32
	Clay	32	34	2
	Quicksand	34	241	207
	Large boulders	at	241	--
205-801-3:	Drilled by Howard Gale			
	Earth	0	5	5
	Gravel	5	22	17
	Clay	22	24	2
	Gravel	24	40	16
	Brown and gray mix; water (at 42 feet)	40	53	13
	Sand, brown	53	69	16
	Gray sand; water (50 gpm)	69	70	1
	Gray and brown mix	70	75	5
	Slate	75	77	2
	Slate and gray sand	77	80	3
	Red mix	80	85	5
205-802-1:	Drilled by G. W. Matthews			
	Clay and stone, yellow; dry	0	83	83
	Clay and gravel; water (16 gpm; cased off)	83	85	2
	Gray clay and stone; dry	85	104	19
	Slate (at 104 feet, enough water to drill with)	104	110	6
	Broken sand; water (10 gpm) static water level -20 feet)	110	130	20
	Sand	130	150	20
	Slate and sand shells (40 gpm at 165 feet)	150	170	20
	Slate	170	175	5
	Slate and red rock	175	180	5
	Slate	180	185	5
	Slate and sand shells	185	190	5
	Sand and red rock (40 gpm at 200 feet)	190	200	10
	Slate	200	205	5
	Broken sand	205	210	5
	Slate and red rock	210	215	5
	Sand and red rock	215	220	5
	Broken sand	220	235	15
	Slate	235	240	5
	Slate and sand shells	240	245	5
	Sand	245	250	5
	Slate and sand shells	250	255	5
	Slate	255	260	5
	Slate and sand shells	260	265	5
	Broken sand	265	270	5
	Sand	270	275	5
	Red rock shells	275	280	5
	Sand and red rock	280	285	5
	Slate and sand shells	285	290	5
	Sand and red rock	290	300	10

Table A2.--Drillers' logs of selected wells and test holes in the Genesee River basin (Continued)

Part 1.--Allegany County, N. Y. (Cont'd.)

		Depth (feet) From	Depth (feet) To	Thickness (feet)
206-756-1:	Drilled by B. M. Williams Co.			
	Topsoil, fine sand	0	18	18
	Blue clay	18	183	165
	Clay and fine sand	183	215	32
	Clay	215	222	7
	Clay and sand	222	238	16
	Gravel, clay, and fine sand	238	244	6
	Sand and clay	244	249	5
	Hard sand and clay	249	264	15
	Fine gravel and sand; dry	264	268	4
	Sand; very little water	268	276	8
	Fine sand, clay	276	288	12
	Clay and fine gravel	288	293	5
	Clay and fine cuttings	293	297	4
	Fine sand and clay	297	306	9
	Slate and rock cuttings	306	310	4
	Quicksand and clay	310	312	2
	Water sand	312	316	4
	Slate, bedrock	316	318	2
206-756-2:	Drilled by S. M. Williams Co.			
	Topsoil and muck	0	27	27
	Coarse gravel and clay	27	32	5
	Fine gravel	32	38	6
	Coarse sand and gravel	38	42	4
	Sand	42	44	2
	Gravel and clay (dry)	44	47	3
	Blue clay	47	57	10
	Medium to fine gravel	57	60	3
	Blue clay	60	61.5	1.5
	Coarse gravel	61.5	66	4.5
	Fine gravel and sand	66	79	13
	Blue clay and gravel	79	84	5
	Hardpan cuttings	84	93	9
	Fine sand and clay	93	98	5
	Pink clay	98	114	16
206-756-3:	Drilled by B. M. Williams Co.			
	Topsoil and mud	0	2	2
	Small gravel; slight amount of water at 44 feet; not enough to drill	2	46	44
	Rock at	46	--	--
206-756-4:	Drilled by B. M. Williams Co.			
	Top fill	0	8	8
	Gravel; some water	8	12	4
	Mud and brown clay	12	80	68
	Gravel, sand, and mud	80	93	13
	Blue clay	93	119	26
	Dirty gravel; some water	119	126	7
	Gravel and sand; no water	126	137	11
	Blue clay	137	162	25
206-756-5:	Drilled by B. M. Williams Co.			
	Topsoil and fill	0	4	4
	Gravel; some water	4	12	8
	Brown clay	12	26	14
	Blue gravel	26	28	2
	Brown clay	28	65	37
	Boulder or bedrock at	65	--	--
206-756-6:	Drilled by B. M. Williams Co.			
	Brown clay	0	24	24
	Fine gravel	24	25	1
	Brown clay	25	26	1
	Gravel; some water	26	27	1
	Brown clay	27	72	45
	Gravel (water flowed over top in night)	72	73	1
	Pink rock and brown clay	73	112	39
	Gravel (static water level -1 foot)	112	113	1
	Blue clay	113	119	6
	Brown clay	119	127	8
206-756-7:	Drilled by B. M. Williams Co.			
	Brown clay	0	58	58
	Gravel and clay (static water level -2 feet)	58	59	1
	Brown clay	59	116	57
	Clay and pink rock	116	126	10
206-756-8:	Drilled by B. M. Williams Co.			
	Fill	0	8	8
	Gravel; some water	8	12	4
	Brown clay	12	84	72
	Quicksand and blue clay	84	85	1
	Blue gravel	85	89	4
	Gray gravel (75-100 gpm)	89	98	9
	Sand	98	99	1
	Blue clay	99	102	3

Part 1.--Allegany County, N. Y. (Cont'd.)

		Depth (feet) From	Depth (feet) To	Thickness (feet)
206-756-9:	Drilled by B. M. Williams Co.			
	Sand, fine gravel; dry	0	42	42
	Soft blue clay	42	123	81
	Fine black sand and blue clay	123	138	15
	Coarse sand; some water	138	142	4
	Soft blue clay	142	145	3
	Gravel and clay	145	151	6
	Medium gravel and sand; water	151	160	9
	Medium gravel; water	160	168	8
	Gravel and clay, hard; water	168	170	2
	Coarse gravel; water	170	173	3
206-756-10:	Drilled by Homer LeBar			
	Gravel	0	10	10
	Blue clay	10	45	35
	Rock	45	72	27
207-754-2:	Drilled by Layne-New York Co.			
	Topsoil and gravel	0	2.5	2.5
	Medium gravel, coarse sand, and clay	2.5	20	17.5
	Gravel and clay	20	26	6
	Hardpan	26	36	10
	Coarse gravel, some fine sand, and some clay	36	50	14
207-756-1:	Drilled by G. W. Matthews			
	Coarse gravel	0	53	53
	Yellow clay	53	176	123
	Quicksand	176	219	43
	Clover-seed sand rock, hard	219	229	10
	White slate, very soft	229	236	7
207-756-3:	Drilled by Homer LeBar			
	Gravel	0	50	50
	Quicksand	50	240	190
	Gravel; water-bearing; at	240	--	--
207-756-5:	Drilled by Homer LeBar			
	Gravel	0	50	50
	Quicksand	50	240	190
	Gravel	240	255	15
209-747-2:	Drilled by Howard Gale			
	Gravel	0	18	18
	Hardpan	18	28	10
	Shale; water (from 30 to 35 feet; 20 gpm; then cased off)	28	35	7
	Slate	35	70	35
	Soft lime	70	80	10
	Slate	80	86	6
	Gray sand; water (15 gpm)	86	90	4
	Slate	90	95	5
	Hard lime	95	99	4
	Soft lime	99	140	41
	Gray sand	140	143	3
	Slate and shell	143	165	22
	Brown lime; water (from 170 to 175 feet; 20 gpm)	165	175	10
	Gray lime and shell; water (40 gpm)	175	200	25
	Slate	200	213	13
	Light gray sand	213	220	7
	Soft lime	220	230	10
	Slate	230	240	10
	Lime and shell	240	250	10
	Slate	250	256	6
	Red rock	256	270	14
	White sand	270	280	10
212-806-1:	Drilled by G. W. Matthews			
	Brown sand, clay, and gravel	0	12	12
	Gray clay	12	97	85
	Gray sand and gravel; water-bearing	97	160	63
	Gray sand and gravel, some clay	160	162	2

Table A2.--Drillers' logs of selected wells and test holes in the Genesee River basin (Continued)

Part 1.--Allegany County, N. Y. (Cont'd.)

		Depth (feet) From	Depth (feet) To	Thickness (feet)
212-806-2:	Drilled by G. W. Matthews (Log of test hole 1 drilled at about this site:)			
	Brown gravel	0	15	15
	Quicksand	15	25	10
	Soft gray clay	25	65	40
	Fine sand	65	70	5
	Fine gravel; first water, 70-75 feet, very little	70	78	8
	Coarse gravel; lot of water	78	80	2
	Fine gravel; lot of water	80	85	5
	Coarse gravel; lot of water	85	90	5
	Fine gravel, lot of sand; water not too good	90	102	12
	Coarse gravel; lot of water, good for screen	102	116	14
	Fine gravel; lot of water; clay, sand; no good	116	128	12
	Coarse gravel; lot of water, screen from 128 to 150 feet	128	151	23
	Clay and gravel; no good	151	153	2
	Coarse gravel; lot of water	153	161	8
	Fine gravel, lot of sand; no good	161	176	15
	Quicksand	176	178	2
212-807-2:	Drilled by Cranston Water Supply (Log of test hole T-5 at this site:)			
	Clay, firm, brown	0	10	10
	Clay, sandy, gray	10	54	44
	Clay, gray	54	72	18
	Clay, brown; some sand and gravel near bottom (first water at 81-foot depth	72	82	10
	Clay, sand and gravel	82	91	9
	Shale, gray	91	154	63
	Shale; sandstone, brown; water started flowing	154	162	8
	Shale, gray	162	180	18
	Shale; sandstone, hard	180	185	5
	Shale; thin layers of sandstone	185	244	59
	Shale; sandstone, light-colored	244	261	17
	Shale, gray	261	276.1	15.1
212-807-3:	Drilled by G. W. Matthews			
	Blue clay	0	78	78
	Gravel; water-bearing	78	83	5
	Clay and cobbles	83	91	8
	Gravel	91	95	4
	Rock	95	165	70
212-808-1:	Drilled by Cranston Water Supply			
	Topsoil, sod	0	1	1
	Clay, brown; some gravel	1	15	14
	Clay, bluish gray	15	65	50
	Sand, fine, silty	65	70	5
	Sand and gravel, clay, very dirty; water-bearing	70	73	3
	Clay, some sand and gravel, hard, yellowish brown	73	105	32
	Clay, pieces of residual shale gravel; bluish gray	105	107	2
212-808-2:	Drilled by Cranston Water Supply			
	Topsoil	0	1	1
	Clay, firm, brown	1	60	59
	Sand, very fine, silty, gray	60	80	20
	Clay, silty, some pebbles, gray	80	105	25
	Sand and gravel, dirty; water-bearing	105	107	2
	Clay, some pebbles, firm, brown	107	174	67
	Clay, sand and gravel, gray	174	181	7
	Sand, gray	181	185	4
	Gray shale with thin layers of sandstone; a little water at 245 feet	185	248	63
212-808-3:	Drilled by Cranston Water Supply			
	Fill	0	5	5
	Clay, gravel, cobbles, boulders, gray	5	10	5
	Clay, gray	10	95	85
	Sand, very fine, silty, gray; little water	95	100	5
	Clay, containing large percent of sand and gravel	100	108	8
	Clay, hard	108	124	16
	Sandstone, cream-colored, hard; cave 140-145 feet	124	144	20
	Shale, gray, soft	144	200	56
	Sandstone	200	204	4
	Shale, gray	204	240	36

Part 1.--Allegany County, N. Y. (Cont'd.)

		Depth (feet) From	Depth (feet) To	Thickness (feet)
212-808-4:	Drilled by Cranston Water Supply			
	Topsoil, sod	0	1.5	1.5
	Clay, brown gravel, hard	1.5	14	12.5
	Clay, gray	14	90	76
	Sand, very fine, silty, gray; water-bearing, little water	90	105	15
	Clay, some sand, brown	105	118	13
	Shale, brown	118	153	35
	Shale, gray	153	180	27
	Sandstone, hard	180	195	15
	Shale, soft	195	260	65
212-809-2:	Drilled by Jim Murray			
	Topsoil and gravel	0	16	16
	Clay	16	20	4
	Quicksand and clay	20	48	28
	Gravel	48	50	2
	Brown sand	50	60	10
	Gravel	60	62	2
213-801-1:	Drilled by Cranston Water Supply			
	Topsoil	0	1	1
	Sand, gravel, cobbles, clay	1	15	14
	Clay, little gravel	15	55	40
	Sand, silty, some clay	55	77	22
	Clay, some gravel	77	84	7
	Clay, silty sand	84	94	10
	Sand; little water	94	95	1
	Clay, firm	95	105	10
	Clay, sand and gravel	105	117	12
	Clay, sand and gravel; little water	117	120	3
	Clay, sand and gravel, firm	120	128	8
	Clay, silty sand	128	158	30
	Clay, some gravel	158	170	12
	Sand, coarse, hard; little water	170	172	2
	Clay, sand and gravel, hard	172	191.5	19.5
	Sand and gravel; water-bearing	191.5	192.5	1
	Clay, some sand and gravel, soft	192.5	198	5.5
	Sand, fine	198	203	5
	Clay, sand and gravel, muddy; little water	203	223	20
	Clay, sand and gravel, cobbles, muddy; little water	223	231	8
	Clay, sand and gravel, hard; no water	231	248	17
	Clay, residual shale gravel	248	252	4
213-801-2:	Drilled by Cranston Water Supply			
	Topsoil	0	1	1
	Sand, gravel, cobbles, loose	1	7	6
	Clay, sand and gravel	7	12	5
	Clay, silt, some pebbles	12	38	26
	Clay, firm	38	115.5	77.5
	Sand and gravel, muddy; water-bearing	115.5	118	2.5
	Clay, some pebbles, firm	118	135	17
	Clay, soft	135	183	48
	Sand and some gravel, hard	183	191	8
	Sand and gravel, muddy; water-bearing	191	192	1
	Clay, sand and gravel, hard	192	228	36
	Clay, soft	228	252	24
	Clay, sand and gravel, firm	252	254	2
	Clay, residual shale gravel	254	263	9
213-802-4:	Drilled by Cranston Water Supply			
	Topsoil	0	1	1
	Clay, some pebbles	1	4	3
	Clay, sand and gravel, cobbles	4	12	8
	Blue clay	12	40	28
	Clay, some sand and gravel	40	72	32
	Clay	72	84	12
	Clay, large pebbles, hard	84	88	4
	Sand and gravel; water-bearing (static water level -26 feet)	88	89	1
	Clay, sand and gravel, hard	89	105	16
	Clay, firm	105	127	22
	Clay, soft	127	135	8
	Sand, very fine, silty, some gravel; little water	135	144	9
	Sand, very fine, silty, more gravel; little water	144	151	7
	Bedrock, shale, dark gray, soft	151	202	51

Table A2.--Drillers' logs of selected wells and test holes in the Genesee River basin (Continued)

Part 1.--Allegany County, N. Y. (Cont'd.)

		Depth (feet) From	Depth (feet) To	Thickness (feet)
214-802-1:	Drilled by Cranston Water Supply			
	Topsoil	0	3	3
	Clay	3	5	2
	Clay, some gravel	5	15	10
	Clay, silty sand, some pebbles	15	24	9
	Clay, silty sand, larger pebbles	24	32	8
	Clay, sand and gravel, soft	32	48	16
	Clay, firm	48	108	60
	Clay, some pebbles	108	125	17
	Clay, soft	125	131	6
	Sand and gravel, muddy	131	133	2
	Sand and gravel, muddy; water-bearing	133	137	4
	Clay, sand and gravel, hard	137	140	3
	Clay, alternating layers of sand and gravel; water-bearing (static water level -20 feet)	140	150	10
	Clay, some pebbles	150	167	17
	Clay, red and firm	167	177	10
	Clay, sand and gravel	177	178	1
	Sand and gravel, hard; water-bearing (static water level -17.5 feet)	178	186	8
	Clay, sand and gravel	186	187	1
	Shale, gray	187	208	21
214-802-3:	Drilled by Cranston Water Supply			
	Topsoil	0	1	1
	Sand and gravel, some clay, brown; no water	1	8	7
	Sand and gravel, layers of coarse gravel; water-bearing	8	17	9
	Clay, gray, smooth, soft	17	20	3
215-758-1:	Drilled by Cranston Water Supply			
	Cobbles and clay	0	11	11
	Sand and soft clay	11	24	13
	Clay, soft; some gravel	24	35	11
	Shale gravel and clay	35	40	5
	Clay, gray	40	53	13
	Cobbles, gravel, sand, dirty	53	57	4
	Clay, yellow; and gravel	57	73	16
	Fine gravel and sand	73	74	1
	Clay, blue; fine gravel	74	133	59
	Gravel and sand, dirty	133	135	2
	Clay, yellow, with gravel	135	152	17
	Gravel, sand, clay	152	158	6
	Clay, yellow; some gravel	158	168	10
	Clay, blue, and cobbles	168	185	17
	Fine gravel and sand	185	186	1
	Clay, blue; cobbles, and gravel	186	208	22
	Shale and calcareous sandstone	208	235	27
	Shale	235	281	46
	Shale and calcareous sandstone	281	291	10
	Shale	291	301	10
220-806-1:	Drilled by Moody's, Inc.			
	Topsoil	0	1	1
	Clay and gravel	1	7	6
	Clay	7	57	50
	Clay and gravel	57	60	3
	Clay	60	141	81
	Gravel and sand, with some clay	141	145	4
	Brown clay	145	146	1
220-807-1:	Driller unknown			
	Brown loam	0	6	6
	Quicksand	6	14	8
	Blue clay	14	64	50
	Loose shale, blue; water-bearing (20 gpm)	64	79.7	15.7
	Sand rock; light vein of water	79.7	81.5	1.8
	Sand rock; more water	81.5	85.5	4
	Blue shale; water (30 gpm)	85.5	100	14.5
	Blue shale, increasingly soft; more water	100	131.5	31.5
225-809-1:	Drilled by Cranston Water Supply (Log of test hole at site of permanent well:)			
	Topsoil	0	1	1
	Clay, yellow	1	6	5
	Clay, blue	6	50	44
	Clay, blue; small percent of sand and gravel	50	119	69
	Sand and gravel, clay; little water	119	123	4
	Clay, soft; some gravel	123	129	6
	Fine sand; silt; little water	129	133	4
	Silty sand; clay; few pebbles	133	145	12
	Sandy clay, hard packed	145	152	7
	Sand, very fine, silty	152	173	21
	Sand, very fine; some clay and pebbles	173	183	10
	Sand, small gravel, dirty; water-bearing (static water level -99 feet)	183	188	5

Part 1.--Allegany County, N. Y. (Cont'd.)

		Depth (feet) From	Depth (feet) To	Thickness (feet)
225-809-1:	(Continued)			
	Clay, fine sand	188	199	11
	Clay, hard packed sand, some pebbles	199	215	16
	Sand, very fine	215	219	4
	Sand and gravel; sand, fine; some layers of clay; clay increasing toward bottom; water-bearing	219	231	12
	Sand and gravel; large percent of clay	231	232.4	1.4
227-806-1:	Drilled by Sawyer			
	Topsoil	0	1	1
	Gravel and sand	1	26	25
	Clay	26	93	67
	Gray quicksand	93	115	22
	Clay	115	116	1
	Black quicksand	116	123	7
	Coarse sand and gravel	123	127	4
	Coarse gravel	127	134	7
	Clay	134	135	1

Part 2.--Genesee County, N. Y.

		Depth (feet) From	Depth (feet) To	Thickness (feet)
252-801-1:	Drilled by Layne-New York Co.			
	Topsoil and yellow clay	0	4	4
	Fine sand and silt	4	16	12
	Medium fine sand, streaks of coarse sand and fine gravel	16	30	14
	Hard packed sand, hard streaks of silt and clay	30	42	12
252-801-2:	Drilled by Cranston Water Supply			
	Topsoil, sod	0	1	1
	Clay, cobbles, gravel, sand	1	3	2
	Sand, coarse, gray; no water	3	10	7
	Sand and gravel, clean; water-bearing	10	12	2
	Clay, silt, gray, soft; wet	12	32	20
	Clay, silt, sand, fine gravel	32	46	14
	Sand and gravel, clay, silty; water-bearing	46	49	3
	Shale, fragments, gray, soft	49	49.5	.5
	Sand and gravel, clay, silty; water-bearing	49.5	52	2.5
	Clay, pieces of shale	52	53	1
	Shale, gray, soft	53	54	1
252-801-3:	Drilled by Cranston Water Supply			
	Topsoil, sod	0	1	1
	Sand, silt; wet	1	5	4
	Sand and gravel, silt, brown; no water	5	12	7
	Clay, very fine sand, some pebbles; wet	12	17	5
	Sand and gravel, very dirty, silt, gray; water-bearing	17	22	5
	Clay, some sand and gravel; little water	22	26	4
	Clay, some sand and gravel; no water	26	38	12
	Clay, fragments of shale, gray; no water	38	42	4
	Clay, slab of shale at 45 feet, gray	42	48	6
	Shale, gray, soft	48	50	2
252-801-4:	Drilled by Cranston Water Supply			
	Topsoil, sod	0	1	1
	Clay, sandy silt, light brown; wet	1	3	2
	Sand, very fine, brown; little water	3	12	9
	Sand and fine gravel, brown; water	12	14	2
	Clay, some sand and gravel, brown; no water	14	20	6
	Clay, some sand and gravel, light gray, hard; no water	20	26	6
	Sand and gravel, cobbles, some clay, muddy; water-bearing (salty taste)	26	30	4
	Clay, small fragments of shale, gray	30	31	1
	Shale, gray	31	32	1

Table A2.--Drillers' logs of selected wells and test holes in the Genesee River basin (Continued)

Part 2.--Genesee County, N. Y. (Cont'd.)

		Depth (feet) From	Depth (feet) To	Thickness (feet)
252-801-5:	Drilled by Cranston Water Supply			
	Topsoil, sod	0	1	1
	Clay, gravel, sand, light brown	1	6	5
	Clay, gravel, sand, silt, brown	6	13	7
	Sand and gravel, clean; water-bearing	13	14	1
	Clay, silty, soft, gray	14	28	14
	Clay, silt, sand, some pebbles, gray	28	36	8
	Clay, silt, sand, gray	36	49	13
	Shale fragment, gray (hard drilling)	49	49.5	.5
	Clay, fine gravel and sand; no water	49.5	54	4.5
	Clay, pieces of gray shale; no water	54	58	4
	Clay, larger pieces of gray shale; no water	58	61.5	3.5
	Shale, bedrock, gray; good drilling; no water	61.5	67	5.5
	Shale, harder than above, gray; water-bearing	67	68	1
252-801-6:	Drilled by Cranston Water Supply			
	Sandy loam	0	14	14
	Sand and gravel, clay, brown	14	16	2
	Sand, fine, brown, some pebbles	16	23	7
	Sand and fine gravel, brown; water-bearing	23	29	6
	Clay, sand and gravel, firm	29	44	15
	Shale; no water	44	44.5	.5
252-801-7:	Drilled by Cranston Water Supply			
	Topsoil	0	1	1
	Sand and gravel, clay, loam; no water	1	14	13
	Clay, some sand and gravel; occasional thin streak of water	14	21	7
	Clay, some sand, gravel, small cobbles, gray; no water	21	38	17
	Clay, smooth, firm, gray	38	43.5	5.5
252-801-8:	Drilled by Cranston Water Supply			
	Topsoil	0	1	1
	Sand and fine gravel, loam, loose	1	9	8
	Sand and fine gravel, brown; water-bearing	9	11	2
	Gravel, fine, clay, tan, soft; no water	11	15	4
	Clay, sand and fine gravel, gray, hard; no water	15	32	17
	Shale, gray; no water	32	33	1
252-801-9:	Drilled by Cranston Water Supply			
	Topsoil	0	1	1
	Sand and fine gravel, loam, loose	1	13	12
	Sand and fine gravel, brown; water-bearing	13	16	3
	Gravel, fine, some sand, tan and brown, clay; no water	16	19	3
	Clay, sand and fine gravel, gray, hard; no water	19	21.5	2.5
252-801-10:	Drilled by Cranston Water Supply			
	Topsoil, sod	0	1	1
	Fill, boulders, cobbles	1	9	8
	Clay, sand and gravel, cobbles	9	17	8
	Sand, fine, silty, brown	17	24	7
	Sand and fine gravel; water-bearing	24	24.5	.5
	Clay, bluish gray	24.5	35	10.5
252-801-11:	Drilled by Cranston Water Supply			
	Topsoil, sod	0	1	1
	Clay, sand, gravel, cobbles, brown	1	9	8
	Clay, sand, gravel, cobbles, gray; drills like hard shale	9	23	14
	Clay, sand and gravel; water in thin streaks (static water level -5.0 feet)	23	49	26
	Shale, gray, soft	49	57	8
	Limestone, hard	57	61	4
	Shale, gray, soft (gas at 83 feet)	61	87	26
252-801-12:	Drilled by Cranston Water Supply			
	Topsoil, sod	0	1	1
	Clay, large percent of sand and gravel	1	5	4
	Clay, some sand and fine gravel, gray	5	17	12
	Sand and gravel, clean; water-bearing	17	18	1
	Clay, silt, fine gravel, soft, bluish gray	18	36	18
	Clay, some sand and larger pebbles than above, firm, gray	36	47.5	11.5
	Sand and gravel, some clay, brown; water-bearing (static water level, about -15 feet)	47.5	50	2.5
	Clay, pieces of shale	50	51	1
	Shale, gray, soft	51	53	2

Part 2.--Genesee County, N. Y. (Cont'd.)

		Depth (feet) From	Depth (feet) To	Thickness (feet)
253-801-2:	Drilled by Cranston Water Supply			
	Topsoil, sod	0	1	1
	Clay, some sand and gravel, yellowish brown	1	6	5
	Clay, fine silty sand, dark gray	6	14	8
	Clay, some pebbles, soft, gray	14	26	12
	Clay, large percent of glacial sand and gravel; occasional thin layer water-bearing and firm--best layer at 32 feet (static water level -6.5 feet)	26	33	7
	Clay, large percent of residual shale gravel, firm, gray; no water	33	44	11
	Shale, light gray; small vein of natural gas	44	45	1
258-809-1:	Drilled by Cranston Water Supply			
	Topsoil	0	1	1
	Clay, sand and gravel	1	29	28
	Sand, gravel, clay; water-bearing	29	36	7
	Sand, fine; clay; water-bearing	36	40	4
	Sand and fine gravel, some clay; water-bearing	40	45	5
	Sand and fine gravel; water-bearing	45	47	2
	Sand, fine gravel, clay	47	49.2	2.2
259-759-1:	Drilled by Myers and Warner			
	Soil	0	28	28
	Lime	28	46	18
	Brown lime with water	46	48	2
	Lime	48	52	4
	Brown lime with water	52	53	1
	Lime	53	57	4
	Brown lime with water	57	59.5	2.5
	Lime	59.5	65	5.5
	Brown lime with water	65	66	1
	Lime	66	71	5
	Brown lime with water	71	73	2
	Lime	73	79	6
	Brown lime with water	79	80	1
	Lime	80	87	7
	Brown lime with water	87	89	2
	Lime	89	99	10
	Brown lime with water	99	101	2
	Lime	101	107	6
	Brown lime with water	107	108	1
	Lime	108	114	6
	Brown lime with water	114	116	2
	Lime	116	124	8
	Brown lime with water	124	125	1
	Lime	125	132	7
	Brown lime with water	132	134	2
	Lime	134	140	6
	Brown lime with water	140	143	3
	Lime	143	150	7
	Brown lime with water	150	152	2
	Lime	152	160	8
	Brown lime with water	160	161	1
	Lime	161	168	7
	Brown lime with water	168	169	1
	Lime	169	179	10
	Brown lime with water	179	181	2
	Lime	181	189	8
	Brown lime with water	189	190	1
	Lime	190	197	7
	Flint	197	211	14
	Brown lime with water	211	212	1
	Lime	212	219	7
	Brown lime with water	219	220	1
	Lime	220	225	5
259-809-1:	Drilled by Moody's, Inc.			
	Yellow clay	0	7	7
	Coarse gravel	7	28	21
	Coarse brown gravel with sand; gravel up to 7 inches in diameter	28	62	34
	Yellow clay and gravel	62	64	2
259-809-2:	Drilled by Layne-New York Co.			
	Gray medium to fine gravel and sand, and patches of clay with boulders	0	5	5
	Gray coarse to fine gravel and sand, and small boulders	5	15	10
	Brown coarse to fine gravel and sand, and small boulders	15	17	2
	Gray medium to fine gravel and sand	17	30.5	13.5
	Gray fine gravel and sand	30.5	44.5	14
	Gray coarse to fine sand, and small boulders	44.5	52	7.5
	Brown coarse to fine sand and gravel	52	67.5	15.5
	Gray coarse to fine sand and gravel	67.5	69	1.5
	Reddish gray clay and boulders at	69	--	--

Table A2.--Drillers' logs of selected wells and test holes in the Genesee River basin (Continued)

Part 2.--Genesee County, N. Y. (Cont'd.)

		Depth (feet) From	Depth (feet) To	Thickness (feet)
259-809-3:	Drilled by Moody's, Inc.			
	Clay	0	15	15
	Clay and gravel	15	30	15
	Coarse to fine gravel and sand	30	61	31
	Coarse to fine sand	61	74	13
	Clay, gravel and sand	74	76	2
	Coarse to fine gravel and sand	76	79	3
	Light clay with gravel at	79	--	--
259-809-5:	Drilled by Moody's, Inc.			
	Coarse to fine gravel and sand	0	15	15
	Fine gravel and sand	15	39	24
	Coarse gravel and sand	39	43	4
	Fine brown sand	43	52	9
	Coarse to fine gravel and sand	52	60	8
	Coarse to fine gravel and coarse sand	60	67	7
	Cemented gravel and clay	67	70	3
259-809-6:	Drilled by Layne-New York Co.			
	Topsoil	0	1	1
	Clay	1	15	14
	Clay, and medium to coarse gravel and sand	15	18	3
	Medium to coarse gravel and sand	18	36	18
	Medium to fine gravel and sand	36	51	15
	Medium to coarse sand and gravel	51	60	9
	Sand, and medium to coarse gravel, and clay; very dirty	60	62	2
	Sand and some gravel	62	72	10
	Medium to coarse gravel and sand	72	79.5	7.5
	Clay and gravel at	79.5	--	--
259-809-7:	Drilled by Moody's, Inc.			
	Coarse brown sand and gravel mix	0	17	17
	Coarse brown gravel and sand mix; water-bearing	17	27	10
	Fine brown sand with pieces of gravel (1-inch mix), sharp	27	28	1
	Fine brown sand (quicksand); water-bearing	28	34	6
	Coarse blue gravel; water-bearing	34	59	25
	Coarse gravel and clay mix, cemented; water-bearing	59	60	1
259-809-8:	Drilled by Moody's, Inc.			
	Coarse brown gravel, hard	0	3	3
	Fine brown sand (quicksand); water-bearing	3	23	20
	Coarse brown gravel and sand mix	23	37	14
	Coarse blue gravel and sand mix; water-bearing	37	41	4
	Blue clay and gravel mix	41	42	1
304-756-1:	Drilled by C. Euler			
	Clay; backfill; clay and mixture of rocks	0	20	20
	Hard limestone rock	20	24	4
	Alternate layers of red clay, shale, and limestone rock	24	40	16
	Limestone rock and shale	40	46	6
304-800-2:	Drilled by Cranston Water Supply			
	Topsoil	0	1	1
	Gray clay	1	20	19
	Gray clay with shale chips	20	30	10
	Very soft gray shale	30	44	14
	Soft gray shale	44	53	9
	Hard gray shale	53	58	5
	Hard gray fractured shale	58	63	8
305-756-2:	Drilled by Layne-New York Co.			
	Topsoil	0.0	0.5	0.5
	Hardpan	.5	1.0	.5
	Clay	1	9	8
	Shale and clay	9	30	21

Part 3.--Livingston County, N. Y.

		Depth (feet) From	Depth (feet) To	Thickness (feet)
232-739-1:	Drilled by Layne-New York Co.			
	Topsoil	0	1.5	1.5
	Sandy clay and some gravel	1.5	5.75	4.25
	Sandy clay and gravel	5.75	14.5	8.75
	Tough blue clay and gravel	14.5	31	16.5
	Tough blue clay	31	53	22
	Hard shale rock	53	59	6
232-741-1:	Drilled by Layne-New York Co.			
	Topsoil and gravel	0	2	2
	Sandy clay	2	5	3
	Coarse gravel, fine sand, and some clay	5	10.5	5.5
	Tough blue clay	10.5	72	61.5
	Tough blue clay and gravel	72	112.5	40.5
	Rock at	112.5	--	--
232-742-1:	Drilled by Layne-New York Co.			
	Fine sand	0	1	1
	Coarse gravel and some fine sand	1	9.5	8.5
	Tough blue clay	9.5	32	22.5
	Medium gravel and clay	32	39.5	7.5
	Blue clay	39.5	78	38.5
	Hard shale rock	78	83.5	5.5
232-742-2:	Drilled by Layne-New York Co.			
	Coarse gravel and sand	0	8	8
	Sandy clay and gravel	8	15	7
	Sandy clay	15	23	8
	Sandy clay and gravel	23	31	8
	Sandy clay	31	80	49
	Tough blue clay and gravel	80	105	25
	Quicksand	105	118	13
	Clay and gravel	118	123	5
	Rock at	123	--	--
233-741-1:	Drilled by Layne-New York Co.			
	Topsoil	0	1	1
	Coarse gravel and some fine sand	1	22	21
	Coarse sand and fine sand	22	27	5
	Medium gravel and fine sand	27	42.5	15.5
	Tough blue clay	42.5	71	28.5
	Shale rock	71	73	2
	Coarse gravel and clay	73	92	19
	Hard shale rock	92	100.5	8.5
233-742-1:	Drilled by Layne-New York Co.			
	Topsoil	0	0.75	0.75
	Coarse gravel and coarse sand	.75	31	30.25
	Sandy clay	31	37.5	6.5
	Coarse gravel and some fine sand	37.5	39.5	2
	Sandy clay	39.5	62	22.5
	Tough blue clay and gravel	62	96	34
	Tough blue clay	96	105.5	9.5
	Tough blue clay and gravel	105.5	107	1.5
	Tough blue clay and some fine sand	107	136.5	29.5
	Soft sand rock and clay	136.5	148	11.5
233-742-2:	Drilled by Layne-New York Co.			
	Topsoil	0	1	1
	Sand and clay	1	2	1
	Coarse gravel, boulders, and coarse sand	2	19.5	17.5
	Coarse gravel and some fine sand	19.5	24.5	5
	Sandy clay and streaks of gravel	24.5	53	28.5
	Sandy clay	53	65	12
	Tough blue clay	65	129	64
	Clay and gravel	129	130	1
	Tough blue clay	130	140	10
	Clay and gravel	140	141	1
	Tough blue clay	141	154	13
233-742-3:	Drilled by Layne-New York Co.			
	Topsoil	0	1	1
	Clay	1	4.75	3.75
	Coarse gravel and coarse sand	4.75	9.5	4.75
	Tough blue clay	9.5	96	86.5
	Clay and gravel	96	113	17
	Coarse gravel and clay	113	121	8
	Medium gravel, sand, and clay	121	193	72
	Coarse gravel, sand, and clay	173	216	23
	Hard shale rock	216	222.5	6.5
234-742-1:	Drilled by Layne-New York Co.			
	Sandy clay	0	3.5	3.5
	Coarse gravel and sand	3.5	12	8.5
	Sandy clay	12	18.5	6.5
	Sandy clay and gravel	18.5	23.5	5
	Sandy clay	23.5	68	44.5
	Tough blue clay	68	94	26
	Tough blue clay and gravel	94	111	17
	Tough blue clay and layers of clay and gravel	111	133.5	22.5
	Clay and gravel	133.5	179	45.5
	Tough blue clay	179	198	19
	Tough blue clay, gravel and fine sand	198	250.5	52.5
	Coarse gravel, clay, and fine sand	250.5	267.5	17
	Sand rock	267.5	275.5	8
234-743-1:	Drilled by Layne-New York Co.			
	Topsoil	0	1	1
	Sandy clay	1	3.5	2.5
	Coarse gravel and coarse sand	3.5	23.5	20
	Clay	23.5	25	1.5
	Coarse gravel and some fine sand	25	30	5
	Sandy clay	30	34.5	4.5
	Coarse gravel and some fine sand	34.5	36.5	2
	Sandy clay and layers of tough blue clay	36.5	122	85.5

Table 42.--Drillers' logs of selected wells and test holes in the Genesee River basin (Continued)

Part 3.--Livingston County, N. Y. (Cont'd.)

		Depth (feet) From	Depth (feet) To	Thickness (feet)
234-743-2:	Drilled by Layne-New York Co.			
	Topsoil	0	1	1
	Sandy clay	1	3.5	2.5
	Coarse gravel and coarse sand	3.5	25	21.5
	Blue clay	25	29	4
	Coarse gravel, sand, and some sandy clay	29	33.5	4.5
	Tough blue clay	33.5	56	22.5
234-743-3:	Drilled by Layne-New York Co.			
	Topsoil	0	2.5	2.5
	Sandy clay and gravel	2.5	8.5	6
	Coarse gravel, sand and some clay	8.5	25	16.5
	Tough blue clay	25	29	4
	Coarse gravel and clay	29	33.5	4.5
	Tough blue clay	33.5	57	23.5
234-743-4:	Drilled by Layne-New York Co.			
	Topsoil and fill	0	4	4
	Sandy clay	4	9	5
	Coarse gravel and coarse sand	9	32	23
	Rock at	32	--	--
234-743-5:	Drilled by Layne-New York Co.			
	Topsoil	0	1	1
	Sandy clay and gravel	1	3	2
	Coarse gravel and coarse sand	3	25	22
	Blue clay	25	29	4
	Clay and gravel	29	38	9
	Tough blue clay	38	54	16
240-737-1:	Drilled by Cranston Water Supply			
	Topsoil	0	2	2
	Clay, gray, soft; small amount of gravel	2	60	58
	Sand and gravel; water (static water level -15 feet)	60	62	2
	Clay, some gravel	62	67	5
	Clay, hard, some sand and gravel	67	80	13
	Sand and gravel; water (static water level -12 feet)	80	81.5	1.5
	Clay, cobbles, sand and gravel	81.5	86	4.5
	Clay, shale gravel	86	90	4
	Shale boulder (prevented driving pipe)	90	92	2
	Shale gravel, sand and gravel, clay; water	92	98	6
	Shale, hard, gritty; no water	98	110	12
240-738-3:	Drilled by Cranston Water Supply			
	Topsoil, fill	0	6	6
	Clay, sandy, blue, very soft	6	33	27
	Clay, sand, gravel, brown, firm	33	62	29
	Clay, blue, firm	62	65	3
	Clay, brown, sand, gravel	65	74	9
	Clay, blue and brown, sand, gravel	74	78	4
	Clay, blue, shale gravel; very small vein of water at depth of 96 feet (static water level -25 feet)	78	97.5	19.5
	Shale, gray, soft; water at 105 feet (8 gpm)	97.5	115	17.5
	Shale, hard, gritty	115	133	18
	Shale, gray, soft (small vein of gas at depth of 135 feet)	133	150	17
243-752-3:	Drilled by Layne-New York Co.			
	Topsoil	0	2	2
	Brown clay	2	10	8
	Gravel and clay	10	14	4
	Coarse gravel, coarse sand, and clay balls	14	23.5	9.5
	Blue clay at	23.5	--	--
243-752-4:	Drilled by Layne-New York Co.			
	Topsoil	0	1	1
	Clay	1	8.5	7.5
	Clay and gravel	8.5	17	8.5
	Coarse gravel, coarse sand, and boulders	17	28.2	11.2
244-750-1:	Drilled by Cranston Water Supply			
	Topsoil	0	1	1
	Clay, yellowish brown, soft	1	29	28
	Sand and gravel, clay; no water	29	31	2
	Sand and gravel; water-bearing (coarse sand to pebble 1 1/2 inches in diameter; static water level -6 feet)	31	38	7
	Clay, blue, soft; some gravel, decreasing with depth	38	50	12

Part 3.--Livingston County, N. Y. (Cont'd.)

		Depth (feet) From	Depth (feet) To	Thickness (feet)
244-750-2:	Drilled by Cranston Water Supply			
	Topsoil	0	1	1
	Silt, sandy, brown	1	18	17
	Silt, more sand; saturated with water, but little free water	18	29	11
	Sand and gravel, water-bearing (coarse sand to pebbles 1 inch in diameter; static water level -5.5 feet)	29	31	2
	Clay, blue, soft	31	41	10
244-750-3:	Drilled by Cranston Water Supply			
	Topsoil	0	1	1
	Clay, sandy, silt, yellowish brown	1	15	14
	Sand and gravel, some clay; no water	15	22	7
	Sand and gravel, occasional thin layer of clay; water-bearing (coarse sand to pebble 2 inches in diameter; coarse gravel between 30 and 32 feet; static water level -5.5 feet)	22	32	10
	Clay, blue, some fine gray sand	32	40	8
244-752-1:	Topsoil	0	1	1
	Clay, yellow	1	10	9
	Clay, dark	10	15	5
	Clay, little gravel; water (at 20 feet; cased off)	15	20	5
	Clay, small streak of gravel; water-bearing	20	23	3
	Sand and gravel; water-bearing	23	29	6
	Gravel, little clay	29	31	2
	Gravel, fine sand	31	32.6	1.6
	Fine silty sand at (no water)	32.6	--	--
244-752-2:	Drilled by Cranston Water Supply			
	Clay, yellow, with sand, gravel, cobbles	0	22	22
	Sand, gravel, cobbles, with layers of clay, yellow; water-bearing	22	35	13
	Fine soft sand with blue clay	35	47	12
244-752-3:	Drilled by Layne-New York Co.			
	Brown clay	0	7	7
	Gray and yellow clay	7	22	15
	Gray gravel and sand, traces of clay	22	31	9
	Gray clay and gravel	31	40	9
	Gray shale and clay	40	80	40
244-752-4:	Drilled by Layne-New York Co.			
	Brown clay	0	6	6
	Brown sand	6	8	2
	Brown gravel and sand	8	26	18
	Gray sandy clay	26	50	24
250-753-2:	Drilled by Cranston Water Supply			
	Topsoil, sod	0	1	1
	Clay, sand and gravel, brown, firm	1	7	6
	Clay, sand, gravel, boulders, gray, firm	7	17	10
	Boulders, cobbles	17	19.5	2.5
	Sand and gravel, medium; water-bearing (static water level -5 feet)	19.5	20	.5
	Sand, very fine, silty	20	23	3
	Sand, gravel; water-bearing	23	27.5	4.5
	Clay, sand and gravel, hard	27.5	28	.5
	Sand and gravel, clean; water-bearing	28	30	2
	Sand and gravel, large percent of clay	30	32.5	2.5
	Sand and gravel, clean; water-bearing	32.5	35	2.5
	Clay, sand and gravel, fine sand	35	39	4
	Clay, sand and gravel, hard	39	49	10
	Clay, residual shale, gravel	49	51.5	2.5
	Shale, gray, soft	51.5	59	7.5
254-734-2:	Drilled by Layne-New York Co.			
	Topsoil	0	1	1
	Yellow sandy clay	1	5	4
	Blue clay and gravel	5	11	6
	Gray sand	11	18	7
	Blue clay, some gravel	18	66	48
	Gravel and blue clay	66	110	44
	Black shale at	110	--	--
254-734-3:	Drilled by Layne-New York Co.			
	Topsoil	0	1	1
	Yellow sandy clay and gravel	1	5	4
	Blue clay and gravel	5	34	29
	Blue clay, some gravel	34	56	22
	Blue clay	56	74	18
	Gravel and blue clay	74	77	3
	Coarse gravel	77	83	6
	Blue clay	83	94	11
	Clay and gravel	94	133	39
	Black shale at	133	--	--

Table A2.--Drillers' logs of selected wells and test holes in the Genesee River basin (Continued)

Part 3.--Livingston County, N. Y. (Cont'd.)

		Depth (feet) From	Depth (feet) To	Thickness (feet)
254-734-4:	Drilled by Layne-New York Co.			
	Topsoil	0	1	1
	Yellow clay and gravel	1	7	6
	Blue clay	7	40	33
	Clay and gravel	40	44	4
	Gravel, little clay	44	54	10
	Coarse sand, some clay	54	61	7
	Blue clay	61	78	17
	Gravel and clay	78	101	23
	Black shale at	101	--	--
254-738-2:	Drilled by Layne-New York Co.			
	Topsoil	0	2	2
	Brown sandy clay	2	9	7
	Gray clay, small gravel	9	18	9
	Large, medium, and small gravel mixed	18	26	8
	Boulders and medium gravel	26	28	2
	Large, medium, and small gravel	28	43	15
	Fine sand to rock	43	50	7
254-745-1:	*Drilled by Layne-New York Co.*			
	Topsoil	0	0.8	0.8
	Sand	.8	24.8	24
	Mud, gravel, and hard clay	24.8	30	5.2
	Shale rock	30	42.8	12.8
258-750-5:	Drilled by Cranston Water Supply			
	Topsoil, sod	0	1	1
	Clay, sand and gravel, brown	1	8	7
	Clay, more sand and gravel, brown	8	13	5
	Sand and gravel, some clay layers; *water-bearing*	13	27	14
	Clay, yellowish brown	27	30	3
	Clay, sand and gravel	30	33	3
	Sand	33	37	4
	Clay, sand and gravel, hard	37	39	2
	Sand and gravel; some water	39	42	3
	Clay, some sand and gravel, hard	42	45.5	3.5
	Limestone	45.5	50	4.5
258-750-6:	Drilled by Layne-New York Co.			
	Topsoil	0	1	1
	Clay, *gravel*, and sand	1	6	5
	Clay, boulders, gravel, and sand	6	10	4
	Clay, gravel, and sand	10	19	9
	Medium-to-coarse sand, gravel, and boulders	19	26.5	7.5

Part 4.--Monroe County, N. Y.

		Depth (feet) From	Depth (feet) To	Thickness (feet)
300-737-1:	Drilled by Harris-Harmon Well Co.			
	Topsoil	0	5	5
	Clay and silt	5	28	23
	Sand and gravel	28	48	20
	Glacial till	48	50	2
	Fine gravel	50	53	3
	Clay and silt	53	69	16
	Boulders	69	70	1
	Clay and silt	70	78	8
	Layers of gravel, cobbles, silt, and fine sand	78	102	24
	Gray clay and cobbles	102	105	3
	Layers of gravel, cobbles, and *fine sand*	105	115	10
	Light gray plastic clay	115	116	1
	Layers of gravel, cobbles, and sand	116	134	18
	Clay, white and gray, plastic	134	139	5
	Layers of gravel, cobbles, and sand	139	141	2
	Hard gray clay	141	142	1
	Gray stony till	142	163	21
	Red stony till	163	168	5
	Thin layers of stony till and coarse gravel	168	183	15
	Gray plastic clay	183	185	2
	Thin layers of stony till and coarse gravel, gray and black	185	199	14
	Black clay with thin streaks of gypsum	199	200	1
	Thin layers of stony *till and* coarse gravel, gray	200	210	10
	Brown plastic clay	210	211	1
	Gray stony till	211	216	5
	Shale boulder	216	218	2
	Sand and gravel, fine to coarse	218	220	2
	Gray, stony, sandy till	220	233	13
	Gray, hard, stony till	233	246	13
	Red and gray sand and gravel, fine to coarse	246	256	10
	Gray stony till	256	259	3
	White and gray plastic clay	259	260	1
	Soft gray stony till	260	275	15
	Brown plastic clay	275	278	3
	Hard gray stony till	278	288	10
	Gray sand and gravel	288	292	4

Part 4.--Monroe County, N. Y. (Cont'd.)

		Depth (feet) From	Depth (feet) To	Thickness (feet)
300-737-1:	(Continued)			
	Hard gray stony till	292	301	9
	Sand and gravel and soft gray clay in thin layers	301	321	20
	Brown hard clay	321	323	2
	Hard gray stony *till*	323	338	15
	Fine sand and gravel	338	340	2
	Gray stony till	340	342	2
	Brown and gray clay (with layers of cobbles at 345 feet)	342	351	9
	Light gray stony till and boulders	351	363	12
	Brown clay (boulder at 365 feet)	363	367	4
	Gray hard stony till and boulders	367	381	14
	Layers of cobbles, and white, gray, coffee, and red clay	381	422	41
	Thin layer of gravel at	422	--	--
	Layers of cobbles, and white, gray, coffee, and red clay	422	436	14
	Soft, light gray clay	436	438	2
	Layers of cobbles, and white, gray, coffee, and red clay	438	470	32
	Brown clay silt	470	471	1
	Layer of cobbles, boulders, and red, gray-green, and brown clay	471	503	32
	Bedrock	503	633	130
300-737-2:	Drilled by Harris-Harmon Well Co.			
	Topsoil	0	4	4
	Clay, silt, and boulders	4	9	5
	Heavy glacial boulder	9	12	3
	Clay, silt, and cobbles	12	13.5	1.5
	Boulders, cobbles, gravel, fine sand, and some clay near top of formation	13.5	66	52.5
	Clay, silt, and cobbles	66	79	13
	Boulders and cobbles	79	80.5	1.5
	Cobble, pebbles, and clay and silt	80.5	85	4.5
	Boulders and cobbles, and clay and silt	85	87	2
	Clay and silt, and cobbles	87	113	26
	Thin layer of fine gravel	113	114	1
	Clay and silt, and cobbles	114	145	31
	Gravel, cobbles, boulders, and sand, fine to coarse (some clay between 145 and 152 feet)	145	182	37
	Layers of gray, gritty clay and gravel	182	187	5
	Layers of gray, gritty clay, red clay, and fine sand	187	197	10
	Fine sand, some clay	197	208	11
	Hard compact mass of gray stony till, coarse gravel, pebbles, and cobbles	208	221	13
	Hard green stony till; very dry	221	226	5
	Hard gray stony till, very dry; soft green stony *till*	226	247	21
	Hard gray stony till	247	346	99
	Gray-brown gritty till	346	365	19
	Shale boulders, conglomeratic mass of green and gray shale and rock gypsum boulders; some white, gray-green, and brown clay, coarse gravel, and pebbles of sandstone, quartz, and granite interlain	365	415	50
	Coarse gravel, sand, clay, pebbles, and *shale*	415	417	2
	Shale bedrock (Vernon Shale)	417	487	70
308-739-1:	Drilled by Cranston Water Supply			
	Fill, cinders, and gravel	0	5	5
	Clay, some sand and gravel	5	15	10
	Sand	15	25	10
	Sand and fine gravel; water-bearing	25	26	1
	Limestone	26	27	1
308-739-2:	*Drilled by Cranston Water Supply*			
	Fill	0	11	11
	Sand	11	20	9
	Sand and fine gravel; water-bearing	20	21	1
	Limestone	21	115	94
	Shale	115	150	35
308-739-3:	Drilled by Cranston Water Supply			
	Topsoil, clay	0	4	4
	Clay, sand, some gravel	4	26	22
	Clay, sand and gravel	26	31	5
	Sand and fine gravel; water-bearing	31	32	1
	Clay, sand and gravel	32	34	2
	Limestone	34	60	26

Table A2.--Drillers' logs of selected wells and test holes in the Genesee River basin (Continued)

Part 4.--Monroe County, N. Y. (Cont'd.)

		Depth (feet) From	Depth (feet) To	Thickness (feet)
308-739-4:	Drilled by Cranston Water Supply			
	Fill, cinders, clay	0	3	3
	Clay, sand and gravel	3	19	16
	Sand and fine gravel; water-bearing	19	20	1
	Limestone (water veins at depths of 36 and 55 feet; static water level -14.8 feet)	20	107	87
308-739-8:	Drilled by Cranston Water Supply			
	Topsoil, sod	0	1	1
	Fill, clay, sand, sandstone, pinkish brown	1	17	16
	Limestone, hard, soft streaks at depths of 20 and 28 feet	17	34	17
	Soft zone in limestone; first water (static water level -25 feet)	34	35	1
	Limestone, hard, brown	35	58	23
	Limestone, hard, gray (bad odor at depth of 68 feet)	58	90	32
	Shale, some limestone, dark brown	90	93	3
	Shale, hard; some water at depth of 107 feet (crevice at 122 feet)	93	150	57
	Shale, softer than above, brown	150	173	23
308-739-9:	Drilled by Cranston Water Supply			
	Topsoil, sod	0	1	1
	Fill, clay, sand, sandstone, pinkish brown	1	23	22
	Limestone, gray, hard	23	35	12
	Soft zone in limestone; first water	35	36	1
	Limestone, gray, hard	36	40	4
	Limestone, brown, soft (most of water obtained at this depth)	40	42	2
	Limestone, brown, hard	42	55	13
308-739-10:	Drilled by Cranston Water Supply			
	Topsoil, sod	0	1	1
	Fill, clay, sand, sandstone, pinkish brown	1	23	22
	Limestone, gray, hard	23	35	12
	Limestone, olive-drab color, not so hard as above	35	41	6
	Limestone, soft zone (most of water obtained at this depth)	41	42	1
	Limestone, brown, very hard	42	50	8
	Limestone, brown, hard	50	55	5
308-739-11:	Drilled by Cranston Water Supply			
	Topsoil, sod	0	1	1
	Clay, some sand and gravel	1	20	19
	Sand and gravel, dirty	20	23	3
	Limestone, gray, hard (crevice at depth of 35 feet)	23	35	12
	Limestone, brown, hard	35	41	6
	Limestone, brown hard, coarse; had crevice	41	42	1
	Limestone, brown, hard	42	50	8
	Limestone, gray, very hard	50	60	10

Part 5.--Ontario County, N. Y.

		Depth (feet) From	Depth (feet) To	Thickness (feet)
247-730-1:	Drilled by Cranston Water Supply			
	Topsoil	0	1	1
	Yellow clay, sand, and gravel	1	9.5	8.5
	Sand and gravel	9.5	10.5	1
	Clay, some gravel	10.5	19	8.5
	Coarse sand and gravel	19	21	2
	Clay, fine sand, wood	21	31.5	10.5
	Coarse sand and gravel	31.5	41	9.5
	Gray clay	41	43	2

Part 5.--Ontario County, N. Y. (Cont'd.)

		Depth (feet) From	Depth (feet) To	Thickness (feet)
247-730-2:	Drilled by Layne-New York Co.			
	Topsoil	0	1	1
	Soft gray sandy clay with gravel	1	15	14
	Gray clay and gravel	15	18	3
	Soft gray sandy clay	18	32	14
	Medium to fine gravel and sand	32	35	3
	Coarse to fine gravel and sand	35	52.9	17.9
	Gray bluish clay	52.9	56.9	4
247-730-4:	Drilled by Cranston Water Supply			
	Brown clay and gravel	0	21	21
	Gravel, sand, and clay	21	23	2
	Clay and fine gravel	23	30	7
	Gravel, fine sand with some clay	30	42	12
	Gravel, coarse sand, and some clay	42	48	6
	Sand, clay, and gravel	48	52	4
	Gravel, coarse sand, and some clay	52	63	11
	Sand, gravel, with some clay	63	96	33
	Silty sand, clay, and gravel	96	102	6
254-733-2:	Drilled by Weaver Bros.			
	Soil	0	4	4
	Clay	4	60	56
	Quicksand, gravel and boulders	60	115	55
	Gravel	115	117	2

Part 6.--Steuben County, N. Y.

208-744-1:	Drilled by Howard Gale			
	Earth	0	6	6
	Gravel	6	36	30
	Brown shale	36	40	4
	Slate	40	56	16
	Gray sand	56	62	6
	Slate	62	65	3
	Red rock, broken	65	72	7
	Gray sand	72	75	3
	Slate	75	89	14
	Gray sand	89	90	1
	Soft lime	90	102	12
	Slate	102	106	4
	Clover seed	106	109	3
	Slate	109	128	19
	Gray sand, hard	128	143	15
	Gray sand, medium	143	148	5
	Gray sand (sulfur odor)	148	164	16
	Slate and sand	164	174	10
	Soft lime	174	184	10
	Hard lime shell	184	185	1
	Broken gray sand and lime	185	190	5
	Broken gray sand	190	203	13
	Soft lime	203	244	41
	Gray sand	244	250	6
	Slate	250	280	30
	Slate (oyster smell)	280	285	5
	Hard shell	285	287	2
	Slate	287	300	13
208-744-2:	Drilled by Howard Gale			
	Earth	0	7	7
	Gravel	7	38	31
	Brown shale	38	42	4
	Slate	42	60	18
	Gray sand	60	65	5
	Red rock	65	74	9
	Gray sand	74	78	4
	Slate	78	90	12
	Soft lime	90	103	13
	Slate	103	108	5
	Clover seed	108	111	3
	Slate	111	130	19
	Gray sand	130	166	36
	Broken sand and slate	166	184	18
	Broken sand and lime	184	245	61
	Gray sand	245	250	5
	Slate and shells	250	300	50
230-740-1:	Drilled by Howard Pickard			
	Topsoil	0	1	1
	Yellow sandy clay	1	49	48
	Sand, fine gravel, clay; water-bearing	49	68	19
	Fine sand (quicksand)	68	84	16
	Sandy clay, gravel, firm	84	155	71
230-741-1:	Drilled by Murphy			
	Topsoil	0	2	2
	Sand, gravel, clay	2	15	13
	Clay	15	19	4
	Gray shale and lime	19	90	71

Table A2.--Drillers' logs of selected wells and test holes in the Genesee River basin (Continued)

Part 6.--Steuben County, N. Y. (Cont'd.)

		Depth (feet) From	Depth (feet) To	Thickness (feet)
232-737-4:	Drilled by Layne-New York Co.			
	Topsoil	0	1	1
	Yellow clay	1	5	4
	Blue clay	5	25	20
	Gray clay	25	27	2
	Gray clay, small gravel, mixed	27	32	5
	Medium and small chunks of hard clay	32	41	9
	Medium and small gravel and sand	41	47	6
	Boulders, large gravel and sand	47	58	11
	Gray clay	58	58.5	.5
	Medium and small gravel and sand	58.5	71	12.5
	Small gravel and sand	71	80	9
	Medium gravel and sand	80	85	5
	Boulders, large gravel and sand	85	91	6
	Medium gravel and sand	91	106	15
232-737-5:	Drilled by Layne-New York Co.			
	Topsoil	0	1	1
	Brown sandy clay	1	14	13
	Gray sandy clay	14	33	19
	Medium to small gravel	33	42	9
	Soft gray clay and gravel	42	47	5
	Medium to small gravel and sand	47	62	15
	Large, medium, and small gravel and sand	62	67	5
	Small gravel and coarse sand	67	72	5
233-734-1:	Drilled by Cranston Water Supply			
	Topsoil, sand, and gravel	0	1	1
	Clay, sand and gravel, brown	1	14	13
	Sand and gravel, fairly clean; water-bearing	14	21	7
	Sand, coarse; water-bearing	21	22	1
	Clay, hard	22	23	1
	Sand and gravel, some clay; water-bearing	23	34	11
	Clay, sand and gravel, brown; no water	34	36	2
	Sand, silty, running	36	62	26
	Clay, gray, soft	62	68	6
233-734-2:	Drilled by Cranston Water Supply			
	Topsoil	0	1	1
	Sand, gravel, clay, brown	1	27	26
	Sand, coarse; water-bearing	27	29	2
	Sand, gravel, clay; water-bearing; very dirty	29	32	3
	Sand and gravel; water-bearing	32	38	6
	Sand, silty, running	38	44	6
	Clay, gray	44	54	10
233-734-3:	Drilled by Cranston Water Supply			
	Topsoil	0	1	1
	Sand, gravel, clay, brown	1	28	27
	Sand, coarse, small pebbles, some silt; water-bearing	28	39	11
	Sand, silty, tendency to run, dirty	39	44	5
	Sand, silty, clay, sticky	44	46	2
233-735-1:	Drilled by Layne-New York Co.			
	Topsoil	0	0.7	0.7
	Sandy clay	.7	10	9.3
	Clay and gravel	10	20	10
	Gravel and sand with bits of clay	20	25	5
	Coarse and fine gravel and sand	25	33	8
	Medium to fine sand	33	49	16
233-735-3:	Drilled by Cranston Water Supply			
	Topsoil	0	0.5	0.5
	Clay, sand and gravel, brown, firm	.5	8	7.5
	Clay, cobbles, boulders, brown	8	11	3
	Clay, sand, and gravel	11	17	6
	Sand and gravel; water-bearing	17	21	4
	Sand, fine, muddy	21	26	5
	Sand and fine gravel; water-bearing	26	33	7
	Sand and gravel, clean; water-bearing	33	42	9
	Clay, some gravel, grayish blue	42	45	3
	Clay, grayish blue, soft	45	85	40
233-735-5:	Drilled by Cranston Water Supply			
	Topsoil, sod	0	1	1
	Clay; large percent of gravel, cobbles, and large boulders	1	14	13
	Clay, fine gravel and sand, gray; no water	14	20	6
	Clay, fine gravel and sand, gray; some water	20	27	7
	Sand and gravel, some silt, gray; water-bearing	27	33	6
	Clay, some fine gravel, gray, firm; no water	33	34	1
	Sand and gravel, clean, coarse gravel (at 36 feet); water-bearing	34	37	3

Part 6.--Steuben County, N. Y. (Cont'd.)

		Depth (feet) From	Depth (feet) To	Thickness (feet)
233-735-5:	(Continued)			
	Clay, large percent of sand and gravel, gray; no water	37	45	8
	Clay, small percent of sand and gravel, gray; softer than above	45	50	5
	Clay, gray, soft and smooth	50	65	15
233-735-6:	Drilled by Cranston Water Supply			
	Topsoil, sod, black loam	0	1	1
	Clay, coarse gravel, gray	1	2	1
	Clay, cobbles, gravel, sand, brown	2	10	8
	Sand and gravel, fine, some clay, gray; water-bearing	10	14	4
	Clay, sand and fine gravel, gray, firm	14	19	5
	Sand and gravel, fine, clay, gray; some water	19	28	9
	Sand and gravel, clean; water-bearing	28	30	2
	Clay, large percent of sand and fine gravel, light gray; some water	30	36	6
	Sand and gravel, fine, clay, gray; water-bearing	36	41	5
	Sand and gravel, very dirty, gray; water-bearing	41	43	2
	Clay, light gray	43	55	12
233-735-7:	Drilled by Cranston Water Supply			
	Topsoil, sod, grain stubble	0	1.5	1.5
	Clay, sand, gravel, brown	1.5	22	20.5
	Sand and gravel, fairly clean, water-bearing	22	34	12
	Sand, medium-grained, some pebbles, silty; water-bearing	34	49	15
	Sand, very fine, silty; running sand	49	57	8
	Clay, soft, bluish gray	57	75	18
234-735-3:	Drilled by Layne-New York Co.			
	Brown clay and gravel	0	5	5
	Medium gravel, some sand and clay	5	15.5	10.5
	Medium to coarse gravel, some sand	15.5	25.5	10
	Coarse gravel, some sand	25.5	38	12.5
	Blue clay	38	--	--
234-735-4:	Drilled by Cranston Water Supply			
	Topsoil, sod	0	1	1
	Clay, sand, and gravel, yellow	1	15	14
	Sand and gravel, clay; little water at 18 feet	15	26	11
	Sand and gravel; water-bearing	26	31	5
	Clay, some sand and gravel, hard, brown; no water	31	34	3
	Sand and gravel, fairly clean; water-bearing	34	38	4
	Sand and gravel, finer than above; water-bearing	38	50	12
	Sand and gravel, coarse, clean; water-bearing	50	53	3
	Sand and gravel, thin streaks brown clay; water-bearing	53	62	9
	Sand and silt, muddy	62	68	6
	Clay, blue	68	85	17
234-735-5:	Drilled by Cranston Water Supply			
	Topsoil	0	1	1
	Sand, gravel, clay	1	4	3
	Clay, some sand and gravel, light brown	4	10	6
	Sand and fine gravel; water-bearing	10	11	1
	Clay, predominantly light brown, occasional thin layer of light green clay with small pebbles	11	28	17
	Clay, some sand and gravel, gray	28	37	9
	Sand and gravel, small pebbles, gray; water-bearing	37	38	1
	Clay, some sand and small pebbles, gray	38	49	11
	Gravel, residual, pieces of shale, gray; water-bearing	49	50	1
	Bedrock: shale, gray; small amount of water	50	62	12

Part 7.--Wyoming County, N. Y.

		Depth (feet) From	Depth (feet) To	Thickness (feet)
233-809-1:	Drilled by John Aronhalt			
	Sandy loam	0	8	8
	Gravel	8	10	2
	Quicksand and clay	10	46	36
	Sand and gravel; water-bearing	46	62	16

Table A2.--Drillers' logs of selected wells and test holes in the Genesee River basin (Continued)

Part 7.--Wyoming County, N. Y. (Cont'd.)

		Depth (feet) From	Depth (feet) To	Thickness (feet)
237-803-2:	Drilled by Layne-New York Co.			
	Brown clay and gravel	0	5	5
	Gray clay and gravel	5	13	8
	Gray sand and gravel; some gray clay	13	28	15
	Gray shale; streaks of clay	28	71	43
238-802-2:	Drilled by Layne-New York Co.			
	Brown clay and gravel	0	8	8
	Gray sand and gravel, and clay	8	225	217
238-802-3:	Drilled by Layne-New York Co.			
	Brown clay and gravel	0	3	3
	Brown and yellow clay and gravel	3	13	10
	Gray sand and gravel; some gray clay	13	75	62
	Gray clay and gravel	75	85	10
238-803-2:	Drilled by Layne-New York Co.			
	Brown clay and gravel	0	6	6
	Gray sand and gravel; some gray clay	6	18	12
	Gray and brown sand and gravel	18	61	43
239-804-2:	Drilled by Cranston Water Supply			
	Clay, cobbles, sand and gravel	0	12	12
	Sand and coarse gravel	12	18	6
	Clay, sand and gravel	18	29	11
	Sand and gravel; water	29	31	2
	Clay, sand and gravel	31	38	7
	Sand and gravel; water	38	42	4
	Sand, fine, gray	42	60	18
	Clay, blue, soft	60	70	10
	Sand and gravel; water	70	82	12
	Clay, sandy, hard	82	100	18
	Clay, fine gravel, hard, blue	100	105	5
	Clay, cobbles, sand and gravel, brown, hard	105	125	20
	Clay, sand and gravel, light brown	125	135	10
	Sand and gravel, clay	135	140	5
	Sand and gravel, some clay; started showing water at 140 feet	140	144	4
	Sand and gravel, brown; water (static -21 feet)	144	168	24
	Sand and gravel, some clay (water shut off at 172 feet)	168	173	5
239-805-1:	Drilled by Cranston Water Supply			
	Topsoil, clay, some gravel	0	32	32
	Sand and gravel; water-bearing	32	40	8
	Clay, very fine sand	40	52	12
	Sand and gravel, thin layer of clay; water-bearing	52	91	39
	Clay, large percent of sand and gravel	91	104	13
	Clay, some sand and gravel, gray	104	131	27
	Clay, gray, soft	131	137	6
	Clay, some fine gravel, light gray	137	147	10
	Clay, some fine gravel, yellowish brown	147	161	14
	Shale, gray, soft	161	182	21
	Shale, gray, harder	182	189	7
	Shale, gray, soft; water-bearing	189	201	12
	Shale, gray, harder	201	203	2
	Shale, gray, alternating hard and soft layers; water-bearing (201-209 feet)	203	232	29
	Shale, light gray, hard (odor of natural gas)	232	236	4
	Shale, gray, soft	236	242	6
251-802-1:	Drilled by Cranston Water Supply			
	Earth fill	0	3	3
	Clay, sand, gravel, cobbles, yellowish brown	3	9	6
	Fine gravel, sand, large percent of clay, yellowish brown	9	21	12
	Fine sand and gravel, thin layers of clay; water-bearing	21	31.7	10.7
251-802-2:	Drilled by Cranston Water Supply			
	Topsoil, sod	0	1	1
	Clay, sand, gravel, cobbles, yellowish brown	1	6	5
	Sand, gravel, yellowish brown; water-bearing	6	9	3
	Sand, gravel, occasional thin layer of clay, brown; water-bearing	9	16	7
	Sand, gravel, clay, brown	16	21	5
	Sand, gravel, brown; water-bearing	21	27	6

Part 7.--Wyoming County, N. Y. (Cont'd.)

		Depth (feet) From	Depth (feet) To	Thickness (feet)
251-802-3:	Drilled by Cranston Water Supply			
	Topsoil, sod	0	1	1
	Sand, clay, some pebbles, brown	1	6	5
	Clay, sand, gravel, cobbles, bluish gray	6	14	8
	Sand, gravel, cobbles, clay, bluish gray; water-bearing	14	15	1
	Sand, gravel, cobbles, large percent of clay, bluish gray	15	17	2
	Sand, gravel, cobbles, clay, bluish gray; water-bearing	17	21	4
	Clay, light gray, soft	21	27	6

Part 8.--Potter County, Pa.

		Depth (feet) From	Depth (feet) To	Thickness (feet)
155-753-1:	Drilled by Germania Drilling Co.			
	Clay and boulders	0	22	22
	Clay	22	67	45
	Gravel, fine sand; some water	67	81	14
	Slate	81	130	49
	Slate and hard shells (10 gpm)	130	150	20
	Hard shells, gray sandstone (40 gpm)	150	183	33
155-753-2:	Drilled by P. H. Fitzstephens			
	Red rock, soft	0	20	20
	Gray gravel, hard	20	31	11
	Red rock, soft	31	36	5
	Gray gravel and sand, hard	36	133	97
	Gray lime, hard	133	240	107
	Gray slate and shells	240	345	105
	Gray lime, hard	345	400	55
	Gray slate, soft	400	435	35
	Red rock, soft	435	442	7
	Dark slate, soft	442	460	18
	Gray sand, hard	460	480	20
	Red rock, soft	480	485	5
	Gray slate, soft	485	498	13
	Red rock, hard	498	505	7
	(Log continues to top of Oriskany Sandstone at depth of 5,004 feet)			
159-752-1:	Driller unknown			
	Loam, dry gravel	0	35	35
	Coarse gravel; water	35	38	3
	Sand and gravel; water	38	43	5
	Medium gravel; water	43	44	1
	Dry gravel	44	50	6
	Medium gravel; water	50	59	9

Table A-3.--Chemical analyses of ground water in the Genesee River basin

Well or spring number	Depth of well (feet)	Water-bearing material or bedrock unit	Date of collection	Temperature (°F)	Silica (SiO_2)	Iron (Fe)	Manganese (Mn)	Calcium (Ca)	Magnesium (Mg)	Sodium (Na)	Potassium (K)	Bicarbonate (HCO_3)	Sulfate (SO_4)	Chloride (Cl)	Fluoride (F)	Nitrate (NO_3)	Dissolved solids	Hardness as $CaCO_3$		Specific conductance (micromhos at 25°C)	pH	Color	Alkyl benzene sulfonate (ABS)
																		Calcium, magnesium	Noncarbonate				
					(Chemical determinations expressed in parts per million)																			
										ALLEGANY COUNTY													
202-746-1	141	Upper shale - sandstone	7-14-65	49	6.4	0.48	0.07	4.6	1.1	196	1.6	222	12	180	0.6	0.0	517	16	0	933	8.2	1	--
-2	331	do.	7-14-65	49	9.5	.79	.12	25	8.1	65	2.4	231	22	22	.3	.3	276	96	0	453	8.0	1	--
-3sp -4sp	--	Sand and gravel	7-14-65	--	--	.17	--	14	6.1	--	--	60	12	3.4	--	3.1	--	60	11	135	7.5	--	--
-6	142	Upper shale - sandstone	7-17-65	48	--	.07	--	11	3.8	--	--	40	14	7.6	--	.1	--	43	10	115	7.3	--	--
204-754-1	450	do.	6- 9-65	48.5	--	.22	--	14	5.6	--	--	250 (CO_3 4)	19	134	--	.0	--	58	0	852	8.4	--	--
204-755-1	180	do.	9-17-65	49	--	.15	--	32	8.8	--	--	207	24	10	--	.1	--	116	0	398	7.9	--	--
-2	168	do.	5-26-65	49.5	11	.07	.01	36	10	31	2.3	204	23	7.8	.2	.5	219	132	0	380	7.7	1	--
204-804-1	350	do.	4-15-64	48.5	--	.23	--	--	--	--	--	--	3.8	18	--	.2	--	96	--	289	7.7	--	--
205-755-1	185	Sand and gravel	9-23-65	52	2.9	.19	.02	16	10	64	2.0	150 (CO_3 6)	5.5	59	.2	.1	233	82	0	458	8.6	1	--
205-801-2	127	Upper shale - sandstone	6-14-65	47.5	--	.12	--	14	4.6	--	--	238 (CO_3 1)	13	169	--	.0	--	54	0	933	8.3	--	--
207-748-sp[a/]	--	Sand and gravel	9-24-65	48	8.1	.02	.01	8.4	2.7	2.4	.7	29	10	.2	.1	2.5	58	32	8	83	7.1	1	--
207-754-2	51	do.	4-30-64	57.5	20	.38	--	43	--	--	--	158	11	12	--	1.7	--	156	47	305	7.2	--	--
Do.	51	do.	8-11-64	57	--	--	--	42	8.3	--	--	158	13	10	--	2.9	--	139	10	304	7.2	--	--
207-755-1	254	Sandstone, or sand and gravel	4-30-64	51	--	.07	--	--	--	--	--	--	14	36	--	.1	--	102	--	310	7.7	--	--
207-756-3	240	Sand and gravel	4-23-64	50.5	--	.64	--	--	--	--	--	--	22	12	--	.1	--	147	--	415	8.0	--	--
Do.	240	do.	8-11-64	50.5	--	--	--	41	14	--	--	256	28	15	--	.1	--	158	0	478	7.4	--	--
207-759-1sp	--	Sand	4-28-64	43.5	--	.00	--	--	--	--	--	--	20	6.0	--	21	--	110	--	136	6.2	--	--
209-747-1	229	Upper shale - sandstone	7-20-65	49	8.6	.11	.03	24	7.8	70	2.2	256	23	11	.3	.2	270	92	0	460	7.9	1	--
209-748-1	210	do.	7- 7-65	50	--	.06	--	2.6	1.1	--	--	296	24	94	--	1.0	--	11	0	791	8.2	--	--
210-758-1	256	do.	5-12-65	49	13	.24	.18	82	18	56	2.3	247	1.4	139	.2	.1	467	278	75	816	7.9	1	--
211-758-1sp -2sp -3sp	--	Sand and gravel	10- 7-65	48	8.1	.03	.01	60	5.2	11	1.0	142	15	45	.2	.4	238	171	54	403	8.1	1	--
211-803-1	280	Upper shale - sandstone	6-29-65	50	--	2.0	--	76	26	--	--	290	34	208	--	.0	--	298	60	1,120	8.0	--	--
212-806-2	157	Sand and gravel	8-19-65	48.5	--	.42	--	41	7.3	--	--	150 (CO_3 4)	23	3.2	--	.1	--	132	2	289	8.4	--	--
212-807-1	217	Upper shale - sandstone	4-14-65	47.5	--	.05	--	--	--	--	--	224	22	2.4	--	.2	--	142	0	378	7.9	--	--
-2	276	do.	4-14-65	49	10	.65	.11	36	6.8	15	1.0	149 (CO_3 2)	17	8.0	.3	.3	173	118	0	289	8.3	1	0.0

a/ Combined sample from 7 of 8 spring galleries.

Table A-3.--Chemical analyses of ground water in the Genesee River basin (Continued)

Well or spring number	Depth of well (feet)	Water-bearing material or bedrock unit	Date of collection	Temperature (°F)	Silica (SiO_2)	Iron (Fe)	Manganese (Mn)	Calcium (Ca)	Magnesium (Mg)	Sodium (Na)	Potassium (K)	Bicarbonate (HCO_3)	Sulfate (SO_4)	Chloride (Cl)	Fluoride (F)	Nitrate (NO_3)	Dissolved solids	Hardness as $CaCO_3$		Specific conductance (micromhos at 25°C)	pH	Color	Alkyl benzene sulfonate (ABS)
																		Calcium, magnesium	Noncarbonate				
					(Chemical determinations expressed in parts per million)																		
ALLEGANY COUNTY (Continued)																							
214-802-1	149	Sand and gravel	3-17-65	49	8.8	1.3	0.14	58	11	64	1.4	345	1.2	32	0.2	1.6	351	190	0	605	7.8	1	0.0
-2	167	do.	3-17-65	49	--	1.2	--	--	--	--	--	356	.0	35	--	1.5	--	194	0	618	7.9	--	--
-3	24	do.	10- 6-65	53	--	.04	--	28	6.8	--	--	80	16	43	--	.1	--	98	32	310	7.0	--	--
218-801-3sp	--	do.	10- 7-65	47.5	--	.03	--	54	15	--	--	288	8.5	5.2	--	.0	--	197	0	456	7.8	--	--
218-809-1	32	do.	8-23-65	50	--	.97	--	38	7.0	--	--	168	.8	1.5	--	.1	--	124	0	260	7.7	--	--
219-756-1sp	--	do.	9- 3-65	45.5	4.5	.10	.00	26	3.6	3.2	1.3	75	19	4.0	.1	2.0	106	80	18	185	7.0	1	--
220-806-1	145	do.	4-15-65	50	5.5	3.6	.07	44	20	114	2.5	355	.0	110	.5	.0	463	192	0	870	7.9	2	.0
-2sp	--	do.	10- 7-65	53	--	.02	--	31	8.6	--	--	143	33	83	--	40	--	113	0	672	7.1	--	--
220-807-1	132	Upper shale - sandstone	9-28-65	49	12	1.2	.12	64	17	95	3.2	399	.2	76	.3	1.2	460	231	0	832	7.9	1	--
220-808-1	298	do.	9-28-65	48.5	--	4.2	--	58	8.6	--	--	220	12	10	--	.0	--	180	0	394	7.6	--	--
225-809-1	234	Sand and gravel	4-12-65	51	9.8	.71	.02	37	9.4	47	1.5	267	.0	15	.4	.0	248	131	0	441	7.7	3	.0
227-746-1	30	do.	11-15-65	48	5.0	.02	.00	35	7.4	6.0	1.9	104	30	8.4	.1	2.7	147	118	33	267	7.2	2	--
227-806-1	135	do.	5-10-65	50.5	9.4	.44	.00	38	9.7	70	1.2	308	6.7	23	.2	1.2	311	135	0	541	7.6	1	--
-3	130	do.	12-31-65	--	--	--	--	--	--	--	--	299	.0	15	--	.5	--	138	0	490	7.8	--	--
228-807-sp[b/]	--	do.	12-31-65	--	--	.06	--	--	--	--	--	159	28	2.5	--	.1	--	164	34	310	7.8	--	--
GENESEE COUNTY																							
252-801-1	35	Sand and gravel	11-19-65	50	--	.05	--	177	48	--	--	457	89	407	--	11	--	638	263	2,120	7.8	--	--
253-803-2	42	Upper shale - sandstone	10-13-65	--	--	--	--	--	--	--	--	--	43	186	--	--	--	424	--	1,260	7.9	--	--
254-801-3	55	Sand and gravel	10-13-65	--	--	--	--	--	--	--	--	--	.4	125	--	--	--	262	--	860	8.2	--	--
255-801-1	125	Upper shale - sandstone	10-13-65	--	--	--	--	--	--	--	--	--	7.8	81	--	--	--	290	--	815	8.1	--	--
255-802-1	53	Sand and gravel	10-13-65	--	--	--	--	--	--	--	--	--	29	28	--	--	--	288	--	604	8.1	--	--
256-759-1	65	Upper shale - sandstone	10-27-65	--	--	--	--	--	--	--	--	--	61	72	--	--	--	392	--	804	8.0	--	--
256-805-1	25	do.	10-14-65	--	--	--	--	--	--	--	--	--	43	66	--	--	--	324	--	798	7.9	--	--
257-756-1	49	do.	9-30-65	--	--	--	--	--	--	--	--	---	37	40	--	--	--	303	--	617	8.0	--	--
257-757-1[d/]	43	do.	10-27-65	--	--	--	--	--	--	--	--	--	150	6.4	--	--	--	428	--	788	8.1	--	--
257-804-1	102	Sand and gravel	10-14-65	--	--	--	--	--	--	--	--	--	4.3	.3	--	--	--	47	--	282	8.0	--	--
258-757-1	215	Limestone - dolomite	11-15-65	--	--	--	--	107	25	--	--	223	180	33	--	.0	--	371	188	786	7.9	--	--
258-803-1	40	do.	10-14-65	--	--	--	--	--	--	--	--	--	23	57	--	--	--	357	--	742	8.0	--	--
258-804-1	60	do.	10-14-65	--	--	--	--	--	--	--	--	--	131	31	--	--	--	439	--	888	8.0	--	--
-2	104	do.	10-20-65	--	--	--	--	--	--	--	--	--	22	24	--	--	--	220	--	524	8.1	--	--

b/ Group of 9 springs.

d/ Sampled after chlorination.

Table A-3.--Chemical analyses of ground water in the Genesee River basin (Continued)

Well or spring number	Depth of well (feet)	Water-bearing material or bedrock unit	Date of collection	Temperature (°F)	Silica (SiO_2)	Iron (Fe)	Manganese (Mn)	Calcium (Ca)	Magnesium (Mg)	Sodium (Na)	Potassium (K)	Bicarbonate (HCO_3)	Sulfate (SO_4)	Chloride (Cl)	Fluoride (F)	Nitrate (NO_3)	Dissolved solids	Hardness as $CaCO_3$		Specific conductance (micromhos at 25°C)	pH	Color	Alkyl benzene sulfonate (ABS)
					(Chemical determinations expressed in parts per million)													Calcium, magnesium	Noncarbonate				
					GENESEE COUNTY (Continued)																		
259-758-2	300	Limestone - dolomite	8-25-64	51.5	6.7	0.26	0.01	83	17	29	2.6	229	80	54	0.3	0.6	397	277	90	648	7.4	4	--
259-759-1	225	do.	8- 6-64	61.5	--	--	--	57	16	--	--	192	44	55	--	1.8	--	209	52	556	7.3	--	--
259-809-1	60	Sand and gravel	5- 8-63	52	--	--	--	--	--	--	--	--	44	33	--	--	--	300	--	635	7.3	--	--
-2	69	do.	5- 6-63	56	--	--	--	--	--	--	--	--	47	37	--	--	--	298	--	648	7.5	--	--
Do.	69	do.	5- 7-63	56	8.9	.02	.00	80	22	20	2.2	315	35	30	.1	.2	360	290	32	624	7.4	2	0.0
300-757-1	43	Gypsum - shale	11- 5-65	--	--	--	--	--	--	--	--	--	300	35	--	--	--	555	--	1,050	8.0	--	--
300-758-1	144	Limestone - dolomite and gypsum - shale	10-27-65	--	--	--	--	--	--	--	--	--	51	97	--	--	--	317	--	824	8.0	--	--
300-800-1	99	do.	10-15-65	--	--	--	--	--	--	--	--	--	64	8.8	--	--	--	320	--	607	7.9	--	--
301-754-2	105	Gypsum - shale	10-13-65	52	--	.42	--	211	63	--	--	276	341	173	--	3.8	--	788	561	2,410	7.8	--	--
-3	44	Sand and gravel	10-29-65	--	--	--	--	--	--	--	--	--	52	31	--	--	--	349	--	695	8.1	--	--
-4	35	do.	11- 5-65	--	--	--	--	--	--	--	--	--	82	10	--	--	--	373	--	681	8.0	--	--
303-803-1	112	do.	10-18-65	--	--	--	--	--	--	--	--	--	1,060	15	--	--	--	1,360	--	2,070	7.8	--	--
303-807-1	--	do.	10-19-65	--	--	--	--	--	--	--	--	--	149	6.2	--	--	--	446	--	832	8.1	--	--
304-756-1	46	Gypsum - shale	11- 9-64	48	7.4	.04	.00	306	48	24	2.8	236	707	36	.2	8.1	1,380	964	770	1,620	7.6	1	.0
304-800-1	22	do.	10-15-65	--	--	--	--	--	--	--	--	--	1,150	15	--	--	--	1,540	--	2,240	7.8	--	--
-2	63	do.	11-15-65	49.5	--	.06	--	430	86	--	--	384	1,020	14	--	2.7	--	1,430	1,110	2,120	7.6	--	--
304-806-2sp	--	do.	10-19-65	--	--	--	--	--	--	--	--	--	1,090	21	--	--	--	1,440	--	2,130	7.9	--	--
305-756-1	50	Sand and gravel	8- 6-64	48.5	--	.18	--	208	59	--	--	436	166	162	--	18	--	762	404	1,650	7.2	--	--
-2	30	Sand and gravel, or gypsum - shale	8- 6-64	49.5	8.5	.94	.04	442	69	82	4.3	308	956	206	.4	7.8	2,100	1,390	1,140	2,420	7.4	5	--
-3	50	Gypsum - shale	11- 5-65	--	--	--	--	--	--	--	--	--	1,220	97	--	--	--	1,630	--	2,560	7.8	--	--
305-804-1	25	Dolomite	10-18-65	--	--	--	--	--	--	--	--	--	63	70	--	--	--	450	--	876	8.1	--	--
306-755-1	45	do.	11- 5-65	--	--	--	--	--	--	--	--	--	141	29	--	--	--	394	--	785	8.1	--	--
307-802-1	65	do.	10-18-65	--	--	--	--	--	--	--	--	--	67	20	--	--	--	338	--	659	8.2	--	--
307-803-1	35	do.	10-18-65	--	--	--	--	--	--	--	--	--	72	82	--	--	--	372	--	850	8.1	--	--
					LIVINGSTON COUNTY																		
229-748-1sp	--	Sand	11-10-65	48.5	--	.04	--	62	15	--	--	214	43	.6	--	.4	--	216	40	413	7.8	--	--
232-755-sp c/	--	Sand and gravel	11-23-65	--	--	.25	--	43	11	--	--	148	30	6.8	--	.7	--	152	31	316	7.6	--	--
235-743-1	450	do.	11-10-65	54.5	--	.45	--	34	26	--	--	278	.0	6.4	--	.0	--	190	0	433	7.3	--	--
237-735-1	30	Sand	9- 9-65	--	--	--	--	--	--	--	--	--	34	17	--	--	--	195	--	425	7.9	--	--

c/ Group of springs.

Table A-3.--Chemical analyses of ground water in the Genesee River basin (Continued)

Well or spring number	Depth of well (feet)	Water-bearing material or bedrock unit	Date of collection	Temperature (°F)	Silica (SiO_2)	Iron (Fe)	Manganese (Mn)	Calcium (Ca)	Magnesium (Mg)	Sodium (Na)	Potassium (K)	Bicarbonate (HCO_3)	Sulfate (SO_4)	Chloride (Cl)	Fluoride (F)	Nitrate (NO_3)	Dissolved solids	Hardness as $CaCO_3$: Calcium, magnesium	Hardness as $CaCO_3$: Noncarbonate	Specific conductance (micromhos at 25°C)	pH	Color	Alkyl benzene sulfonate (ABS)
					(Chemical determinations expressed in parts per million)																		
LIVINGSTON COUNTY (Continued)																							
239-746-2	60	Sand and gravel	11-15-65	--	--	0.77	--	64	20	--	--	543	21	318	--	0.0	--	241	0	1,790	7.6	--	--
240-738-2	65	do.	8-27-64	50.5	8.0	.02	0.00	55	12	7.0	1.2	176	33	16	0.2	7.1	235	187	42	393	7.8	3	--
241-749-1	23	Alluvium	11-22-65	--	--	.00	--	148	40	--	--	380	112	294	--	7.3	--	536	224	1,700	7.5	--	--
-2	18	do.	11-22-65	--	--	.49	--	136	36	--	--	384	81	312	--	1.6	--	490	175	1,680	7.5	--	--
243-753-sp c/	--	Sand and gravel	11-22-65	--	--	.03	--	75	15	--	--	230	48	6.4	--	4.9	--	249	60	477	7.9	--	--
246-751-1	33	Alluvium	10- 5-65	--	--	--	--	--	--	--	--	--	129	30	--	--	--	378	--	755	7.8	--	--
249-740-1	170	Sand and gravel	4-21-65	53	13	6.0	.03	60	27	42	1.8	378	.0	25	.4	12	376	262	0	644	7.3	4	0.1
250-753-1sp		do.	11-26-65	48.5	--	.10	--	137	43	--	--	342	103	135	--	4.8	--	518	238	1,140	7.3	--	--
253-736-1	75	do.	9-15-65	--	--	--	--	--	--	--	--	--	.6	.8	--	--	--	142	--	417	8.3	--	--
253-738-2	85	Upper shale - sandstone	9-21-65	--	--	--	--	44	28	--	--	341	.2	6.0	--	2.7	--	224	0	517	8.2	--	--
253-747-1	120	Sand	9-30-65	--	--	--	--	--	--	--	--	--	1,430	3,540	--	--	--	2,760	--	12,100	7.7	--	--
253-757-1	78	Upper shale - sandstone	10-26-65	--	--	--	--	--	--	--	--	--	0	402	--	--	--	336	--	1,770	7.9	--	--
254-738-2	42	Sand and gravel	4-22-65	49	13	.61	.07	107	45	10	1.2	375	132	17	.4	.3	525	451	143	814	7.8	1	.0
256-735-1	105	Limestone - dolomite	9-15-65	--	--	--	--	--	--	--	--	--	79	12	--	--	--	270	--	526	7.9	--	--
257-749-1	55	Sand and gravel	9-28-65	--	--	--	--	--	--	--	--	--	51	21	--	--	--	402	--	766	8.2	--	--
-2	56	do.	11- 3-65	--	--	.02	--	90	34	--	--	282	57	58	--	49	--	366	135	799	8.0	--	--
257-751-1	36	Limestone - dolomite	9-28-65	--	--	--	--	--	--	--	--	--	89	52	--	--	--	363	--	777	8.4	--	--
258-746-1	52	Sand and gravel	9-28-65	--	--	--	--	--	--	--	--	--	505	20	--	--	--	727	--	1,230	7.8	--	--
258-749-1	68	do.	9-28-65	--	--	--	--	--	--	--	--	--	991	41	--	--	--	1,270	--	1,960	7.9	--	--
258-750-2	48	Limestone - dolomite	8-25-64	--	7.8	.23	.02	515	38	31	2.5	128	1,160	50	.4	.1	2,140	1,440	1,340	2,150	7.6	4	--
-5	50	Sand and gravel	9-10-64	50.5	7.4	.02	.01	151	24	75	3.1	251	206	129	.2	25	773	475	269	1,220	7.6	1	.1
-6	26	do.	11-12-65	52	--	.02	--	223	35	--	--	244	396	154	--	15	--	703	502	1,610	7.6	--	--
MONROE COUNTY																							
256-733-1	85	Limestone - dolomite	1- 4-35	48	--	.3	--	36	37	--	--	390	79	1	--	.5	--	242	--	--	--	--	--
256-742-1	110	do.	3-11-35	51	--	.55	--	114	49	--	--	264	125	99	--	75	--	486	--	--	--	--	--
256-743-1	30	Unconsolidated deposit	1-12-35	--	--	.01	--	132	61	--	--	587	176	84	--	18	--	580	--	--	--	--	--
257-735-2	105	Limestone - dolomite	5-11-65	49	7.8	.64	.01	120	32	74	4.0	309	127	140	.5	3.1	748	434	181	1,140	7.6	1	--
257-739-2	60	do.	1-16-35	49	--	.23	--	134	52	--	--	284	319	7	--	.3	--	548	--	--	--	--	--
257-741-1	60	do.	5-20-35	--	--	.03	--	118	36	--	--	408	94	58	--	140	--	443	--	--	--	--	--

c/ Group of springs.

Table A-3.--Chemical analyses of ground water in the Genesee River basin (Continued)

Well or spring number	Depth of well (feet)	Water-bearing material or bedrock unit	Date of collection	Temperature (°F)	Silica (SiO_2)	Iron (Fe)	Manganese (Mn)	Calcium (Ca)	Magnesium (Mg)	Sodium (Na)	Potassium (K)	Bicarbonate (HCO_3)	Sulfate (SO_4)	Chloride (Cl)	Fluoride (F)	Nitrate (NO_3)	Dissolved solids	Hardness as $CaCO_3$		Specific conductance (micromhos at 25°C)	pH	Color	Alkyl benzene sulfonate (ABS)
																		Calcium, magnesium	Noncarbonate				
					(Chemical determinations expressed in parts per million)																		
MONROE COUNTY (Continued)																							
257-742-1	110	Quicksand	8-14-34	52	--	--	--	--	--	--	--	144	--	17	--	--	--	1,012	--	--	--	--	--
258-734-1	100	Limestone - dolomite	9-16-65	--	--	--	--	--	--	--	--	--	51	3.2	--	--	--	282	--	515	8.3	--	--
-2	32	Sand and clay	1-15-35	51	--	0.07	--	68	35	--	--	312	91	5	--	4	--	314	--	--	--	--	--
258-737-1	75	Limestone - dolomite	5-15-35	50	--	.13	--	99	40	--	--	309	138	32	--	.10	--	412	--	--	--	--	--
258-739-1	85	Gravel	8-20-34	50	--	--	--	--	--	--	--	248	--	5	--	--	--	1,215	--	--	--	--	--
-2	1,600	Gypsum - shale and dolomite	8-20-34	48	--	--	--	--	--	--	--	255	--	89	--	--	--	1,160	--	--	--	--	--
258-740-2	30	Unconsolidated deposit	3-19-35	50	--	.06	--	148	53	--	--	492	97	97	--	150	--	587	--	--	--	--	--
258-741-1	23	do.	1-12-35	52	--	.05	--	138	46	--	--	362	155	34	--	60	--	534	--	--	--	--	--
259-735-1	60	Gravel	5-15-35	--	--	.87	--	127	34	--	--	249	103	180	--	325	--	456	--	--	--	--	--
259-736-1	25	Sand	3-12-35	--	--	.09	--	97	53	--	--	361	150	41	--	50	--	460	--	--	--	--	--
259-737-1	108	Clay	8-20-34	50	--	--	--	--	--	--	--	382	--	5	--	--	--	315	--	--	--	--	--
259-738-1	100	Sand	1- 7-35	52	--	.1	--	166	66	--	--	281	406	35	--	20	--	686	--	--	--	--	--
259-740-1	103	Gypsum - shale	8-14-34	49	--	--	--	--	--	--	--	232	--	1	--	--	--	1,370	--	--	--	--	--
259-746-1	21	Gravel	3-26-35	--	--	.1	--	146	42	--	--	298	281	17	--	(trace)	--	537	--	--	--	--	--
259-753-1	75	Limestone - dolomite	5-27-35	48	--	.70	--	86	18	--	--	246	73	1	--	15	--	289	--	--	--	--	--
300-735-1	95	Gypsum - shale	12-26-34	50	--	.06	--	73	47	--	--	318	110	6	--	.5	--	376	--	--	--	--	--
300-746-1	29	do.	11-18-64	50.5	8.9	.10	0.00	332	54	12	2.7	199	816	28	0.5	4.2	1,490	1,050	887	1,670	7.8	1	0.0
300-753-1	22	Unconsolidated deposit	3-20-35	52	--	(trace)	--	133	43	--	--	238	277	4.4	--	25	--	508	--	--	--	--	--
301-740-1	25	do.	5-21-35	52	--	.05	--	87	30	--	--	299	83	11	--	17	--	341	--	--	--	--	--
301-742-1	13	Sand	11- 3-65	--	--	.10	--	124	43	--	--	406	205	47	--	.0	--	487	154	940	7.8	--	--
-2	42	Gypsum - shale	3-14-35	49	--	.19	--	175	44	--	--	274	393	20	--	12	--	617	--	--	--	--	--
-3	70	Quicksand	4-23-35	53	--	11	--	358	38	--	--	240	832	7.6	--	0	--	1,051	--	--	--	--	--
301-746-1	49	Gypsum - shale	1-28-35	50	--	.01	--	116	75	--	--	636	63	13	--	.50	--	613	--	--	--	--	--
301-750-1	90	do.	1-29-35	--	--	.03	--	125	39	--	--	345	169	5	--	15	--	473	--	--	--	--	--
301-752-1	55	Limestone - dolomite	2- 6-35	49	--	.10	--	147	75	--	--	452	141	108	--	135	--	675	--	--	--	--	--
302-735-1	44	Sand	12-26-34	48	--	.07	--	84	41	--	--	313	97	40	--	50	--	378	--	--	--	--	--
302-737-1	50	Quicksand	3-18-35	--	--	.05	--	127	87	--	--	702	134	159	--	125	--	576	--	--	--	--	--
302-740-1	45	Gravel	3-19-35	50	--	.58	--	91	50	--	--	312	123	45	--	35	--	433	--	--	--	--	--
302-742-1	76	Gypsum - shale	10-28-65	--	--	--	--	--	--	--	--	--	1,330	9.0	--	--	--	1,670	--	2,430	7.9	--	--
302-751-1	70	do.	1-29-35	48	--	.15	--	104	45	--	--	412	118	15	--	4	--	445	--	--	--	--	--

Table A-3.--Chemical analyses of ground water in the Genesee River basin (Continued)

Well or spring number	Depth of well (feet)	Water-bearing material or bedrock unit	Date of collection	Temperature (°F)	Silica (SiO_2)	Iron (Fe)	Manganese (Mn)	Calcium (Ca)	Magnesium (Mg)	Sodium (Na)	Potassium (K)	Bicarbonate (HCO_3)	Sulfate (SO_4)	Chloride (Cl)	Fluoride (F)	Nitrate (NO_3)	Dissolved solids	Hardness as $CaCO_3$: Calcium, magnesium	Hardness as $CaCO_3$: Noncarbonate	Specific conductance (micromhos at 25°C)	pH	Color	Alkyl benzene sulfonate (ABS)
					(Chemical determinations expressed in parts per million)																		
MONROE COUNTY (Continued)																							
303-739-1	175	Gypsum - shale	3-12-35	53	--	0.05	--	237	44	--	--	364	442	10	--	0.75	--	772	--	--	--	--	--
303-741-1	98	Unconsolidated deposit	1-21-35	50	--	.6	--	103	45	--	--	367	138	7	--	2.5	--	442	--	--	--	--	--
303-748-1	16	do.	5-21-35	50	--	.03	--	101	41	--	--	432	52	6.6	--	18	--	435	--	--	--	--	--
303-755-1	38	Gypsum - shale	3-26-35	51	--	.15	--	119	73	--	--	364	149	320	--	10	--	597	--	--	--	--	--
304-738-4	22	Sand	1-28-35	49	--	.20	--	390	156	--	--	258	1,343	8	--	.50	--	1,615	--	--	--	--	--
304-740-1	35	Unconsolidated deposit	3-25-35	50	--	.06	--	87	40	--	--	396	120	75	--	300	--	382	--	--	--	--	--
304-746-1	50	Gypsum - shale	4- 2-35	--	--	.08	--	96	40	--	--	427	47	7	--	15	--	404	--	--	--	--	--
304-751-1	22	do.	1-22-35	50	--	.15	--	141	43	--	--	314	232	13	--	25	--	529	--	--	--	--	--
304-753-1	48	Unconsolidated deposit	2- 4-35	50	--	.25	--	395	58	--	--	334	938	11	--	2.0	--	1,226	--	--	--	--	--
304-755-1	40	do.	3-27-35	50	--	.05	--	110	42	--	--	319	160	7.4	--	25	--	447	--	--	--	--	--
305-737-1	90	Gypsum - shale	3-14-35	50	--	.82	--	80	36	--	--	88	420	4.6	--	0	--	347	--	--	--	--	--
305-739-1	65	Sand	1-29-35	50	--	.06	--	31	11	--	--	112	42	4	--	0	--	123	--	--	--	--	--
305-746-1	33	Unconsolidated deposit	5-21-35	50	--	.11	--	86	65	--	--	391	168	13	--	4	--	481	--	--	--	--	--
305-749-1	25	Clay	3-26-35	50	--	.03	--	122	56	--	--	387	110	82	--	150	--	535	--	--	--	--	--
305-753-1	60	Dolomite	2- 7-35	50	--	.05	--	128	37	--	--	333	187	15	--	.5	--	472	--	--	--	--	--
-2	45	Gravel	2- 6-35	--	--	.10	--	160	47	--	--	372	355	18	--	8.5	--	593	--	--	--	--	--
306-740-1	35	do.	3-25-35	--	--	.03	--	140	68	--	--	424	147	21	--	150	--	629	--	--	--	--	--
306-743-1	42	Dolomite	1-21-35	--	--	.05	--	73	20	--	--	188	66	25	--	50	--	264	--	--	--	--	--
306-749-1	62	do.	3-25-35	--	--	.1	--	162	48	--	--	284	376	3	--	(trace)	--	602	--	--	--	--	--
306-751-1	20	Gravel	2-16-35	50	--	.04	--	119	58	--	--	500	114	27	--	25	--	535	--	--	--	--	--
306-752-1	115	Dolomite	11-18-64	50	12	.05	0.00	78	35	9.2	3.4	282	107	12	0.6	.2	445	340	108	646	8.0	1	0.0
306-754-1	55	do.	3-27-35	48	--	.06	--	99	40	--	--	388	86	16	--	5	--	412	--	--	--	--	--
307-743-1	35	Gravel	4- 1-35	47	--	.04	--	71	30	--	--	302	49	6.4	--	1.0	--	300	--	--	--	--	--
307-748-1	27	Dolomite	2-19-35	51	--	.02	--	90	36	--	--	344	79	10	--	10	--	373	--	--	--	--	--
307-752-1	40	do.	3-26-35	50	--	.03	--	132	42	--	--	292	238	2	--	60	--	502	--	--	--	--	--
307-754-1sp	--	Sand and gravel	11-22-65	50.5	--	.02	--	107	40	--	--	318	123	24	--	26	--	432	171	817	7.5	--	--
307-759-1	40	Dolomite	6- 6-35	50	--	.03	--	79	29	--	--	291	52	6	--	20	--	317	--	--	--	--	--
308-744-1	60	do.	1-31-35	--	--	.02	--	76	34	--	--	251	95	7.0	--	38	--	339	--	--	--	--	--
-2	35	do.	8-30-34	--	--	--	--	--	--	--	--	293	--	11	--	--	--	518	--	--	--	--	--
308-745-1	30	do.	2-12-35	50	--	.42	--	78	34	--	--	314	93	13	--	4	--	335	--	--	--	--	--
309-743-1	35	do.	2-11-35	51	--	1.4	--	62	25	--	--	200	66	11	--	25	--	258	--	--	--	--	--

Table A-3.--Chemical analyses of ground water in the Genesee River basin (Continued)

Well or spring number	Depth of well (feet)	Water-bearing material or bedrock unit	Date of collection	Temperature (°F)	Silica (SiO_2)	Iron (Fe)	Manganese (Mn)	Calcium (Ca)	Magnesium (Mg)	Sodium (Na)	Potassium (K)	Bicarbonate (HCO_3)	Sulfate (SO_4)	Chloride (Cl)	Fluoride (F)	Nitrate (NO_3)	Dissolved solids	Hardness as $CaCO_3$: Calcium, magnesium	Hardness as $CaCO_3$: Noncarbonate	Specific conductance (micromhos at 25°C)	pH	Color	Alkyl benzene sulfonate (ABS)
					(Chemical determinations expressed in parts per million)																		
MONROE COUNTY (Continued)																							
309-745-1	26	Dolomite	3-27-35	50	--	0.03	--	56	20	--	--	211	91	8	--	15	--	220	--	--	--	--	--
309-753-1	39	do.	2-15-35	50	--	.6	--	93	38	--	--	337	56	16	--	60	--	389	--	--	--	--	--
309-758-1	60	do.	4-15-35	48	--	.89	--	68	25	--	--	268	45	.0	--	10	--	273	--	--	--	--	--
ONTARIO COUNTY																							
247-730-1	42	Sand and gravel	5-11-65	51	6.9	.06	0.01	50	16	5.0	1.0	183	41	6.8	0.0	1.1	217	190	40	379	7.7	1	--
-4	91	do.	11-12-65	51	--	.18	--	62	19	--	--	216	56	8.4	--	.0	--	232	55	462	7.8	--	--
252-727-1	110	Till	11- 4-65	--	--	--	--	--	--	--	--	--	31	77	--	--	--	11	--	761	8.2	--	--
252-731-1	71	Sand and gravel	11- 4-65	--	--	--	--	--	--	--	--	--	32	10	--	--	--	282	--	540	8.1	--	--
254-733-2	117	do.	11- 4-65	--	--	--	--	--	--	--	--	--	11	3.0	--	--	--	236	--	508	8.1	--	--
STEUBEN COUNTY																							
228-740-1	86	Sand	12-21-65	47.5	--	--	--	--	--	--	--	180	.0	22	--	.0	--	132	0	344	8.0	--	--
232-737-6	38	Sand and gravel	11-15-65	--	--	--	--	63	18	--	--	214	53	7.4	--	.0	--	232	56	454	7.6	--	--
233-735-2	80	--	11-23-65	51	--	.11	--	32	6.6	--	--	151	11	3.4	--	.0	--	107	0	266	7.5	--	--
234-735-2	41	Sand and gravel	8-27-64	46.5	11	3.3	5.1	79	17	36	4.3	300	26	57	.2	1.4	382	267	21	672	7.2	3	--
-4 d/	59	do.	11-24-65	48	--	.02	--	66	15	--	--	180	39	27	--	6.2	--	226	78	466	7.7	--	--
WYOMING COUNTY																							
232-803-1	50	Upper shale - sandstone	12-31-65	--	--	--	--	--	--	--	--	554	342	108	--	.2	--	880	425	1,670	6.9	--	--
233-809-1	62	Sand and gravel	11-17-64	49	--	.00	--	--	--	--	--	125	34	7.0	--	.3	--	139	36	281	8.0	--	--
233-810-1sp	--	do.	11-23-65	47.5	--	.05	--	55	11	--	--	140	32	23	--	9.1	--	183	68	395	7.6	--	--
233-816-2sp	--	do.	11-24-65	47	--	.03	--	47	10	--	--	155	23	4.0	--	6.4	--	158	31	315	7.5	--	--
234-815-1	34	do.	11-24-65	48	9.3	.73	.07	51	11	4.7	.7	181	26	4.2	.1	.0	198	172	24	345	7.8	2	--
236-804-1	8	Sand	4-29-65	43	--	.06	--	--	--	--	--	192	27	25	--	.9	--	178	20	391	7.8	--	--
-2	17	Sand and gravel	4-29-65	44	9.8	3.8	.08	60	15	6.1	.9	214	43	3.2	.3	.2	243	212	36	411	8.1	1	0.0
239-805-1	242	Upper shale - sandstone	11-17-64	49	--	.71	--	--	--	--	--	262	7.7	77	--	.0	--	184	0	638	7.5	--	--
-2	91	Sand and gravel	11-17-64	49	--	.53	--	--	--	--	--	148	24	.6	--	.2	--	133	12	275	8.1	--	--
239-809-1	20	do.	11- 3-65	--	--	.06	--	67	13	--	--	152	46	30	--	34	--	221	46	491	7.8	--	--
249-804-1	88	do.	11- 5-64	50	7.5	.00	.00	62	16	8.6	1.7	178	54	24	.1	8.4	288	220	74	468	7.9	1	.0
251-802-1	32	do.	11- 9-64	53	7.4	.02	.00	112	21	48	10	325	54	93	.2	36	543	365	98	952	7.4	1	--

d/ Sampled after chlorination.

Table A-3.--Chemical analyses of ground water in the Genesee River (Continued)

| Well or spring number | Depth of well (feet) | Water-bearing material or bedrock unit | Date of collection | Temperature (°F) | (Chemical determinations expressed in parts per million) | | |

Table A4.--Sanitary and radiological analyses of ground water in the Genesee River basin, 1964-65

(Analyses by the New York State Department of Health; chemical results in parts per million, unless otherwise noted)

(Note: The data below are listed in the order given on NYSDH form number San. 228, revised Feb. 1964.)

H_2S: a = Very slight odor
b = Slight odor
c = Decided odor
d = Distinct odor

Well or spring number	Date of collection	Color (units)	H_2S	Turbidity (units)	Temperature (°F)	Temperature (°C)	Specific conductance (micromhos)	pH	Carbon dioxide as CO_2 (ppm)	Coliform group (MPN/100 ml)	Bacteria (per ml. agar, 36°C, 24 hours)	Chloride (Cl)	Phosphates (PO_4)	Hardness as $CaCO_3$	Total alkalinity as $CaCO_3$	Residue on evaporation: Total	Residue on evaporation: Volatile	Ammonia nitrogen as N	Organic nitrogen as N	Nitrite nitrogen as N	Nitrate nitrogen as N	Total apparent ABS	Radioactive elements: Rn-222 (picocuries per liter)	Radioactive elements: Ra-226 (picocuries per liter)
ALLEGANY COUNTY																								
202-746-1	10-12-65	2	c	25	52	11	1,475	9.2	--	8.8	6	525	2.0	20	191	1,091	73	0.41	0.17	0.001	0.12	<0.03	---	--
202-746-2	7-20-65	1	-	<1	54	12	359	7.9	0	2.2	1	14	<.1	132	177	223	80	.14	.17	.001	.02	<.03	---	--
-6	7-20-65	1	-	<1	55	13	175	6.5	15	<2	1	7	<.1	44	39	77	57	.08	.06	.002	.16	<.03	---	--
204-755-2	7-20-65	1	-	<1	57	14	300	7.9	4	8	1	14	<.1	132	167	233	94	.17	.11	.004	.02	<.03	---	--
207-748-Sp (about 60 springs)	7-22-65	0	-	2	46	8	87	6.6	10	5	--	3	.2	40	31	68	68	.07	.11	.003	.60	<.03	---	--
207-754-2	8-11-64	25	-	8	57	14	265	7.4	--	--	--	12	4.5	136	124	192	77	.01	.17	.001	.24	<.03	625	0.04
-2	7-28-65	--	-	--	--	--	--	--	--	5	1	--	--	---	--	--	--	--	--	--	--	--	---	--
207-756-3	8-11-64	23	-	5	50	10	405	8.0	--	15	4	13	.2	150	204	291	53	.07	.22	.001	.02	<.03	371	.33
209-747-1	7-22-65	0	d	1	50	10	520	7.7	3	8.8	4	11	<.1	90	216	279	151	.14	.67	.004	.02	<.03	---	--
209-748-1	7-22-65	0	d	<1	55	13	590	8.9	0	<2	5	108	.3	18	257	521	243	.30	.17	.001	.02	<.03	---	--
210-758-1	7-22-65	10	d	6	50	10	620	7.4	7	15	51	195	<.1	240	207	651	385	.30	.67	.002	.02	<.03	---	--
211-758-Sp (3 springs)	7-28-65	0	-	<1	52	11	275	7.4	7	38	1	43	.1	164	116	282	124	.01	.11	.002	.02	<.03	---	--
212-806-2	8-19-64	10	b	<5	48	9	270	7.7	--	--	--	3	.2	132	120	153	56	.05	.22	.001	.02	--	---	--
212-807-1	7-15-65	0	-	0	54	12	275	7.4	9	2.2	1	7	.2	150	206	239	55	.08	.22	.002	.02	<.03	---	--
-2	7-15-65	5	d	4	54	12	205	7.6	4	<2	1	13	.3	120	127	258	72	.14	.22	.001	.02	<.03	---	--
214-802-1	7-14-65	28	-	9	59	15	450	7.7	7	2.2	20	35	2.0	230	287	396	143	.70	3.98	.001	.02	.03	---	--
-2	7-14-65	20	b	9	57	14	400	7.7	10	2.2	5	36	1.8	194	287	366	108	.80	.39	.001	.02	<.03	---	--
-3	7-14-65	0	-	4	54	12	150	6.6	16	>240	390	23	.4	74	53	170	71	.01	1.85	.001	.40	<.03	---	--
218-801-3Sp (1 spring)	10-19-65	<5	c	1	50	10	290	7.5	6	5	55	1.5	.5	220	233	281	77	.18	.11	.001	.02	<.03	---	--
219-756-1Sp (1 spring)	8- 5-65	0	-	<1	46	8	125	6.8	14	--	--	5	.2	84	63	53	0	.01	.11	.001	.20	<.03	---	--
-1Sp (1 spring)	10-19-65	--	-	--	--	--	--	--	--	15	1,100	--	--	---	--	--	--	--	--	--	--	--	---	--
220-806-1	7-15-65	60	-	40	55	13	600	7.5	12	<2	2	110	2.1	210	293	493	123	3.50	.11	.002	.02	<.03	---	--
-2Sp (1 spring)	10-19-65	<5	-	1	54	12	450	6.4	89	38	3	84	.7	120	115	465	106	.01	.22	.002	10.00	<.03	---	--

Table A4.--Sanitary and radiological analyses of ground water in the Genesee River basin, 1964-65 (Continued)

Well or spring number	Date of collection	Color (units)	H_2S	Turbidity (units)	Temperature (°F)	Temperature (°C)	Specific conductance (micromhos)	pH	Carbon dioxide as CO_2 (ppm)	Coliform group (MPN/100 ml)	Bacteria (per ml., agar, 36°C, 24 hours)	Chloride (Cl)	Phosphates (PO_4)	Hardness as $CaCO_3$	Total alkalinity as $CaCO_3$	Residue on evaporation: Total	Residue on evaporation: Volatile	Ammonia nitrogen as N	Organic nitrogen as N	Nitrite nitrogen as N	Nitrate nitrogen as N	Total apparent ABS	Radioactive elements: Rn-222 (picocuries per liter)	Radioactive elements: Pa-226 (picocuries per liter)
ALLEGANY COUNTY (Cont'd.)																								
220-807-1	7-15-65	50	b	12	54	12	400	7.3	18	<2	1	51	0.4	210	310	402	94	0.70	0.17	0.002	0.02	<0.03	---	--
220-808-1	9-28-65	5	-	3	48	9	350	7.4	--	--	--	9	.1	184	180	228	112	.13	.17	.002	.02	.07	---	--
225-809-1	7-14-65	15	a	4	57	14	310	7.6	4	<2.2	1	21	.9	136	220	259	107	1.75	.28	.001	.02	<.03	---	--
227-746-1	8- 5-65	0	-	<1	50	10	175	7.1	8	8.8	1	6	.3	116	80	102	26	.01	.22	.001	.54	<.03	---	--
227-806-1	7-19-65	5	a	<1	54	12	380	7.6	1	8.8	1	20	.6	170	255	379	106	.50	.17	--	.02	<.03	---	--
228-807-Sp (group of springs)	7-28-65	0	-	<1	66	19	230	7.5	4	38	1	4	.2	172	130	206	86	.01	.06	.002	.20	<.03	---	--
GENESEE COUNTY																								
252-801-1	7-26-65	0	-	1	54	12	1,600	7.1	61	<2.2	11	470	.1	620	371	1,466	467	.02	.06	.003	.04	<.03	---	--
258-757-1	10-13-65	2	-	1	52	11	575	6.3	--	--	--	34	.1	360	187	551	117	.03	.17	.001	.04	<.03	---	--
259-758-2	8-25-64	5	-	<5	52	11	590	8.0	--	<2.2	8	49	.1	292	176	434	147	.04	.17	.003	.04	<.03	684	0.10
259-759-1	8- 6-64	15	-	50	61	16	500	7.7	--	240	--	55	1.1	208	144	490	158	.03	.95	.001	.08	--	---	--
301-754-2	10-13-65	<1	-	<1	52	11	1,700	7.1	28	<2.2	1	460	.2	780	231	1,695	447	.03	.11	.050	1.00	.03	---	--
304-756-1	11- 9-64	2	-	--	48	9	1,590	--	--	<2.2	--	40	.1	1,040	275	1,730	457	.004	.11	.001	1.60	<.03	608	.06
305-756-2	8- 6-64	10	-	5	50	10	2,450	7.1	--	15	5	170	<.2	1,370	290	2,404	557	.48	.17	.002	.36	<.04	371	.06
LIVINGSTON COUNTY																								
229-748-1Sp (1 spring)	8- 5-65	0	-	<1	52	11	275	7.5	3	8.8	1	7	.2	200	152	139	16	.01	.17	.001	.04	<.03	---	--
232-755-Sp (group of springs)	8- 3-65	2	-	2	55	13	200	7.5	1	>240	1,500	9	.1	204	133	140	12	.07	.56	.006	.06	<.03	---	--
235-743-1	7-13-65	12	a	3	55	13	420	7.6	3	<2.2	1	8	.2	200	229	239	102	.37	.28	.001	.02	<.03	---	--
239-746-2	7-13-65	30	d	10	57	14	1,400	7.3	48	<2.2	28	300	.2	210	425	977	181	2.00	.28	.002	.02	<.03	---	--
240-738-2	8-27-64	--	-	<5	50	10	359	7.6	--	<2.2	1	14	.3	184	138	251	102	.01	.11	.001	1.00	<.03	694	.04
241-749-1	7-21-65	0	-	<1	63	17	1,210	7.1	35	2.2	1	270	<.1	510	295	1,077	333	.06	.06	.004	.10	<.03	---	--
-2	7-21-65	15	-	6	59	15	1,225	7.0	38	240	120	315	<.1	470	269	1,093	369	.07	.11	.040	2.20	<.03	---	--
243-753-Sp (about 30 springs)	7-21-65	7	-	1	73	23	350	7.7	3	5	104	13	<.1	188	135	264	92	.09	.56	.020	.80	<.03	---	--
249-740-1	7-13-65	75	b	22	61	16	440	7.1	36	2.2	14	28	1.0	270	333	412	127	4.00	.28	.001	.02	<.03	---	--
254-738-2	7-13-65	10	b	4	50	10	520	7.3	27	5	11	24	1.4	440	302	672	236	.17	.22	.001	.02	<.03	---	--
258-750-2	8-25-64	5	-	<5	--	--	2,040	7.8	--	2.2	9	44	.2	1,480	175	2,574	575	<.01	.22	.001	.02	<.03	---	--
-5	9-10-64	<5	-	<5	50	10	1,160	7.5	--	<2.2	1	125	.1	500	221	465	191	<.01	2.40	.001	10.00	<.03	566	.17

Table A4.--Sanitary and radiological analyses of ground water in the Genesee River basin, 1964-65 (Continued)

Well or spring number	Date of collection	Color (units)	H_2S	Turbidity (units)	Temperature (°F)	Temperature (°C)	Specific conductance (micromhos)	pH	Carbon dioxide as CO_2 (ppm)	Coliform group (MPN/100 ml)	Bacteria (per ml. agar, 360C, 24 hours)	Chloride (Cl)	Phosphates (PO_4)	Hardness as $CaCO_3$	Total alkalinity as $CaCO_3$	Residue on evaporation: Total	Residue on evaporation: Volatile	Ammonia nitrogen as N	Organic nitrogen as N	Nitrite nitrogen as N	Nitrate nitrogen as N	Total apparent ABS	Radioactive elements: Rn-222 (picocuries per liter)	Radioactive elements: Ra-226 (picocuries per liter)
MONROE COUNTY																								
257-735-2	7-27-65	0	d	<1	59	15	710	7.2	--	<2.2	1	56	0.1	460	243	642	313	0.03	0.17	0.002	0.02	<0.03	---	--
300-746-1	11-18-64	5	-	2	50	10	1,700	7.5	--	<2.2	--	31	.1	1,120	237	1,674	182	.01	.28	.004	.50	<.03	---	--
306-752-1	11-18-64	3	-	1	50	10	640	7.7	--	<2.2	--	15	.1	350	254	518	82	.09	.11	.001	.02	<.03	245	0.13
ONTARIO COUNTY																								
247-730-1	7-27-65	0	-	<1	55	13	310	7.5	--	<2.2	1	9	.1	204	150	207	149	.03	.06	.002	.16	<.03	---	--
STEUBEN COUNTY																								
232-737-6	7-21-65	13	-	8	57	14	350	7.5	4	<2.2	1	5	<.1	204	163	276	140	.04	.06	.002	.02	<.03	---	--
233-735-2	10-20-65	<5	-	--	55	13	265	8.0	--	<2.2	200	4	.2	106	119	212	46	.12	.11	.001	.02	<.03	---	--
234-735-2	7-23-64	80	-	10	--	--	560	7.2	--	<2.2	--	41	<.2	250	247	398	116	1.20	.56	.004	.06	--	---	--
-2	8-27-64	15	-	25	46	8	611	7.3	--	<2.2	1	54	.2	250	243	429	156	1.75	.67	.001	.02	<.03	---	--
-4	10-20-65	<5	-	1	50	10	380	7.6	1	<2.2	1	25	.1	208	140	430	158	.02	.11	.001	1.60	<.03	---	--
WYOMING COUNTY																								
233-809-1	11-17-64	1	-	1	49	9	360	7.7	--	<2.2	--	9	.1	196	160	251	31	.01	.56	.020	.04	<.03	347	.17
233-810-1Sp (1 spring)	7-26-65	0	-	<1	57	14	275	6.7	27	8.8	2	17	.1	184	120	264	89	.03	.11	.002	2.40	<.03	---	--
233-816-2Sp (1 spring)	7-26-65	0	-	<1	54	12	280	7.5	2	5	22	4	.1	156	128	149	37	.03	.03	.002	.14	<.03	---	--
234-815-1	7-26-65	0	-	<1	54	12	300	7.4	4	<2.2	1	7	.1	172	148	181	51	.03	.06	.002	.02	<.03	---	--
236-804-1	7-29-65	0	-	1	50	10	475	7.2	18	21	88	58	.2	300	174	333	110	.02	.28	.001	.40	<.03	---	--
-2	7-29-65	2	-	1	52	11	375	7.4	7	2.2	1	9	.1	250	179	228	90	.03	.22	.001	.02	<.03	---	--
239-805-1	11-17-64	10	d	16	49	9	580	7.6	--	<2.2	--	82	.1	172	201	418	13	.42	.84	.006	1.00	<.03	---	--
-2	11-17-64	15	b	4	49	9	320	7.9	--	<2.2	--	3	.1	172	160	220	10	.088	.06	.001	.02	<.03	287	.31
249-804-1	11- 5-64	2	-	1	50	10	520	7.3	--	<2.2	--	26	.1	280	202	412	151	.014	.17	.001	1.80	<.03	716	.08
251-802-1	11- 3-64	1	-	--	53	12	890	--	--	<2.2	--	120	.1	380	260	662	332	.004	<.06	.001	8.75	<.03	187	.18

Table A-5.--Chemical analyses of streams in the Genesee River basin during low flows, 1964 and 1965

NOTE: Samples were collected at times when most of the streams in the basin had discharges in the 95- to 99-percent-duration range.

Name of site (stream number)	Site number (4-)	Latitude (north)	Longitude (west)	County	Discharge of stream at time of sampling (cfs)	Date of collection (time)	Temperature (°F)	Iron (Fe)	Calcium (Ca)	Magnesium (Mg)	As Na (calculated) Sodium (Na)	As Na (calculated) Potassium (K)	Bicarbonate (HCO_3)	Sulfate (SO_4)	Chloride (Cl)	Nitrate (NO_3)	Hardness as $CaCO_3$ Calcium, magnesium	Hardness as $CaCO_3$ Noncarbonate	Specific conductance (micromhos at 25°C)	pH
								(Chemical determinations expressed in parts per million)												
Genesee River at Hickox, Pa. (Ont. 117)	2203	41°58'33"	77°51'26"	Potter	1.9 (estimated)	9-22-64 (1155)	65	0.27	14	4.6	8.0		61	10	7.5	0.5	54	4	146	8.0
Middle Branch Genesee River at Hickox, Pa. (Ont. 117-204)	2203.1	41°58'30"	77°51'28"	do.	1.9 (estimated)	9-22-64 (1210)	63	.33	13	3.5	7.6		53	9.6	6.4	1.2	47	4	130	7.2
West Branch Genesee River near Genesee, Pa. (Ont. 117-202)	2203.3	41°59'04"	77°52'31"	do.	1.5 (estimated)	9-22-64 (1220)	65	.33	13	4.0	8.5		62	10	3.8	.6	49	0	135	7.4
Cryder Creek near Whitesville, N. Y. (Ont. 117-201)	2203.6	42°02'42"	77°45'34"	Allegany	1-2 (estimated)	9-22-64 (1130)	57	.42	15	5.2	16		54	19	20	1.8	59	15	200	6.9
Marsh Creek at Stone Dam, N. Y. (Ont. 117-192)	2203.88	42°01'55"	77°56'29"	do.	.07-.1 (estimated)	9-23-64 (1335)	71	.44	112	22	80		73	10	336	.2	370	310	1,220	7.1
Ford Brook at Stannards, N. Y. (Ont. 117-189)	2204.1	42°04'03"	77°55'43"	do.	.8 (9-21-64)	9-23-64 (1310)	69	.11	40	11	143		113 (CO_3 1)	8.4	250	.0	145	51	1,000	8.3
Chenunda Creek at Stannards, N. Y. (Ont. 117-187)	2204.3	42°05'06"	77°54'36"	do.	1.0 (9-21-64)	9-22-64 (1100)	66	.16	16	4.6	32		84	16	30	.1	59	0	267	8.0
Dyke Creek near West Greenwood, N. Y. (Ont. 117-184)	2204.5	42°08'41"	77°44'07"	Steuben	.1	9-22-64 (1350)	60	.12	19	4.0	41		53	24	60	.1	64	20	336	7.4
Quig Hollow Brook near Andover, N. Y. (Ont. 117-184-16)	2204.55	42°08'45"	77°45'25"	Allegany	.04	9-22-64 (1405)	65	.07	52	16	226		132	124	320	.3	196	88	1,480	7.9
Marsh Creek tributary near Andover, N. Y. (Ont. 117-184-11-1)	2204.6	42°11'22"	77°46'02"	do.	.01	9-22-64 (1430)	59	.21	11	2.6	7.1		37	16	4.6	.3	38	8	113	6.9
Railroad Brook near Alfred, N. Y. (Ont. 117-184-10-4)	2204.65	42°12'51"	77°47'47"	do.	.03	9-22-64 (1455)	59	.28	35	9.6	26		159	32	13	.4	127	0	348	7.8
Elm Valley Creek near Elm Valley, N. Y. (Ont. 117-184-5)	2204.8	42°11'16"	77°51'00"	do.	.04 (9-22-64)	9-23-64 (1415)	60	.00	18	4.4	14		65	22	11	2.2	63	10	198	6.7
Brimmer Brook near Wellsville, N. Y. (Ont. 117-180)	2212	42°07'30"	77°58'43"	do.	.5 (9-22-64)	9-21-64 (1550)	70	.07	49	12	115		77	21	238	.1	171	108	939	8.0
Vandermark Creek near Scio, N. Y. (Ont. 117-176)	2215.1	42°10'02"	77°57'31"	do.	.3	9-21-64 (1530)	74	.06	21	5.5	12		63	17	22	.2	75	24	210	8.0
Knight Creek at Scio, N. Y. (Ont. 117-175)	2215.2	42°10'15"	77°59'17"	do.	1.5	9-21-64 (1515)	74	.06	54	15	186		86	34	352	.0	198	128	1,350	7.5
Gordon Brook at Scio, N. Y. (Ont. 117-173)	2215.3	42°10'44"	77°59'37"	do.	.06	9-21-64 (1455)	76	.30	20	7.3	12		84 (CO_3 6)	20	4.0	.2	80	1	200	8.8
Phillips Creek near Belmont, N. Y. (Ont. 117-167)	2215.6	42°14'23"	78°00'54"	do	1.0	9-21-64 (1425)	73	.11	31	6.4	12		124	20	5.0	1.0	104	2	251	7.8
Van Campen Creek at Friendship, N. Y. (Ont. 117-164)	2216	42°12'22"	78°07'46"	do.	1.1	9-23-64 (1225)	63	.17	36	9.7	20		125	21	35	.9	130	28	348	7.3

Table A-5.--Chemical analyses of streams in the Genesee River basin during low flows, 1964 and 1965 (Continued)

Name of site (stream number)	Site number (4-)	Latitude (north)	Longitude (west)	County	Discharge of stream at time of sampling (cfs)	Date of collection (time)	Temperature (°F)	Iron (Fe)	Calcium (Ca)	Magnesium (Mg)	As Na (calculated) Sodium (Na)	As Na (calculated) Potassium (K)	Bicarbonate (HCO_3)	Sulfate (SO_4)	Chloride (Cl)	Nitrate (NO_3)	Hardness as $CaCO_3$ Calcium, magnesium	Hardness as $CaCO_3$ Noncarbonate	Specific conductance (micromhos at 25°C)	pH
								(Chemical determinations expressed in parts per million)												
Angelica Creek at West Almond, N. Y. (Ont. 117-155)	2216.1	42°18'02"	77°53'09"	Allegany	0.07-.1 (estimated)	9-17-64 (1445)	56	0.05	39	6.0	14		143	18	12	0.1	122	5	296	7.6
Black Creek near Scholes, N. Y. (Ont. 117-155-9)	2216.4	42°22'02"	77°55'16"	do.	.2-.3 (estimated)	9-17-64 (1335)	69	.32	28	5.4	7.6		105	15	4.5	.7	92	6	218	7.4
East Branch Baker Creek near Allen Center, N. Y. (Ont. 117-155-2)	2217.02	42°22'33"	77°59'03"	do.	.02 (estimated)	9-17-64 (1230)	61	.12	32	4.9	8.5		119	14	4.7	.2	100	2	228	7.6
West Branch Baker Creek near Aristotle, N. Y. (Ont. 117-155-2-4)	2217.04	42°21'20"	78°00'56"	do.	<.01 (estimated)	9-17-64 (1150)	61	--	26	5.1	8.5		92	24	2.0	1.1	86	10	203	7.5
Baker Creek tributary near Aristotle, N. Y. (Ont. 117-155-2-3)	2217.06	42°20'34"	78°01'05"	do.	.01-.02 (estimated)	9-17-64 (1135)	56	--	35	6.4	6.2		126	21	1.7	.2	114	11	242	7.2
Baker Creek near Angelica, N. Y. (Ont. 117-155-2)	2217.1	42°18'31"	78°02'38"	do.	.3	9-17-64 (1030)	63	.14	39	9.4	13		160	23	6.1	.2	136	5	315	7.7
White Creek near Belfast, N. Y. (Ont. 117-149)	2217.6	42°18'53"	78°06'28"	do.	.09 (9-20-64)	9-21-64 (1350)	69	.20	35	8.6	8.7		118	32	8.4	.2	123	26	279	7.9
Black Creek at Rockville, N. Y. (Ont. 117-148)	2218	42°18'08"	78°09'49"	do.	.2 (9-20-64)	9-21-64 (1330)	69	--	34	7.0	7.8		124	19	6.5	.6	114	12	256	7.5
Wigwam Creek at Belfast, N. Y. (Ont. 117-147)	2218.1	42°20'04"	78°05'54"	do.	.1 (9-20-64)	9-22-64 (1015)	60	.07	44	9.0	8.5		160	28	3.8	.1	147	16	311	8.1
Crawford Creek at Oramel, N. Y. (Ont. 117-140)	2218.3	42°21'37"	78°08'58"	do.	.3 (9-20-64)	9-21-64 (1230)	65	.19	38	12	8.5		158	25	4.4	.1	143	14	301	8.2
Caneadea Creek at Rushford, N. Y. (Ont. 117-136)	2219	42°22'56"	78°15'16"	do.	2.3	9-23-64 (1135)	68	.29	36	14	6.7		165	20	3.3	.3	146	11	301	7.8
Caneadea Creek tributary at Rushford, N. Y. (Ont. 117-136-12)	2219.4	42°23'45"	78°15'18"	do.	.2	9-23-64 (1115)	67	.07	38	11	8.0		157 (CO_3 2)	18	5.8	.2	141	9	293	8.4
Rush Creek at McGrawville, N. Y. (Ont. 117-136-4)	2219.7	42°21'32"	78°12'15"	do.	1.1 (9-23-64)	9-22-64 (0945)	62	.15	35	9.8	6.4		151	14	2.7	.0	128	4	265	8.0
Sixtown Creek near Hume, N. Y. (Ont. 117-118-2)	2225.12	42°28'45"	78°09'48"	do.	.1-.2 (estimated)	9-23-64 (1045)	68	.34	42	16	10		184	26	12	.2	172	21	362	7.9
Cold Creek at Hume, N. Y. (Ont. 117-118)	2225.3	42°28'23"	78°08'12"	do.	2.8 (9-20-64)	9-21-64 (1145)	70	.22	46	11	7.4		172	27	5.6	.1	161	20	333	7.9
Rush Creek at Fillmore, N. Y. (Ont. 117-117)	2225.4	42°27'54"	78°05'47"	do.	.2 (9-20-64)	9-22-64 (0900)	64	.09	59	20	10		213	57	11	.7	228	54	455	8.0
Wiscoy Creek at Pike, N. Y. (Ont. 117-104)	2227	42°33'19"	78°09'19"	Wyoming	7-9 (estimated)	9-23-64 (0940)	62	.13	42	12	6.7		146	22	16	3.0	153	34	325	7.6
East Koy Creek at Gainesville, N. Y. (Ont. 117-104-3)	2228.5	42°38'17"	78°08'39"	do.	20 (estimated)	11- 3-65 (1740)	46	--	--	--	--		147	38	21	2.3	127	6	346	7.9

Table A-5.--Chemical analyses of streams in the Genesee River basin during low flow, 1964 and 1965 (Continued)

Name of site (stream number)	Site number (4-)	Latitude (north)	Longitude (west)	County	Discharge of stream at time of sampling (cfs)	Date of collection (time)	Temperature (°F)	Iron (Fe)	Calcium (Ca)	Magnesium (Mg)	As Na (calculated) Sodium (Na)	As Na (calculated) Potassium (K)	Bicarbonate (HCO_3)	Sulfate (SO_4)	Chloride (Cl)	Nitrate (NO_3)	Hardness as $CaCO_3$ Calcium, magnesium	Hardness as $CaCO_3$ Noncarbonate	Specific conductance (micromhos at 25°C)	pH
								(Chemical determinations expressed in parts per million)												
East Koy Creek at East Koy, N. Y. (Ont. 117-104-3)	2229	42°32'27"	78°05'54"	Wyoming	7.2	9-23-64 (1010)	65	0.17	42	20	6.7		169	34	17	4.4	187	48	387	7.7
Wolf Creek at Silver Springs, N. Y. (Ont. 117-87)	2233.5	42°39'53"	78°05'05"	do.	.1-.3 (estimated)	9-23-64 (0915)	58	2.4	66	50	345		238	36	630	1.7	372	177	2,390	7.6
Canaseraga Creek at Rosses, N. Y. (Ont. 117-66)	2245.3	42°31'12"	77°53'24"	Livingston	.1-.3 (estimated)	9-16-64 (0850)	--	.14	38	9.2	5.8		147	18	3.9	1.4	133	12	274	7.8
Canaseraga Creek near Swain, N. Y. (Ont. 117-66)	2245.4	42°30'11"	77°52'53"	Allegany	.1-.3 (estimated)	9-16-64 (1710)	54	--	38	9.2	5.8		148	17	4.6	.7	133	12	279	7.3
Ewart Creek near Swain, N. Y. (Ont. 117-66-42)	2245.45	42°28'27"	77°51'40"	do.	.01-.05 (estimated)	9-16-64 (0930)	--	.03	41	12	12		76	100	8.9	.3	152	90	369	7.2
Canaseraga Creek at Swain, N. Y. (Ont. 117-66)	2245.6	42°28'42"	77°50'58"	do.	.05-.09 (estimated)	9-16-64 (1655)	60	1.6	16	4.4	5.8		66	10	3.5	1.2	58	4	142	7.6
Canaseraga Creek tributary near Swain, N. Y. (Ont. 117-66-41)	2245.65	42°28'31"	77°50'37"	do.	.1-.2 (estimated)	9-16-64 (1645)	54	.14	22	5.6	4.8		72	24	3.0	.6	78	19	322	7.2
Canaseraga Creek near tributary Whitney's Crossings, N.Y. (Ont. 117-66-38)	2246.1	42°27'23"	77°50'08"	do.	.01-.02 (estimated)	9-16-64 (1630)	57	.08	36	9.0	16		150	23	10	.1	127	4	306	7.7
Bennett Creek at Canaseraga, N. Y. (Ont. 117-66-32)	2246.3	42°27'35"	77°47'07"	do.	.01-.02 (estimated)	9-16-64 (1620)	53	.23	38	9.2	9.9		125	36	10	.4	133	30	302	7.3
Slader Creek near Canaseraga, N. Y. (Ont. 117-66-31)	2246.4	42°26'32"	77°46'47"	do.	.01-.05 (estimated)	9-16-64 (1600)	59	.17	41	9.2	8.3		142	32	5.8	.1	140	24	304	7.7
Canaseraga Creek near Canaseraga, N. Y. (Ont. 117-66)	2246.5	42°28'18"	77°45'24"	Livingston	1.1	9-16-64 (1005)	48	.08	47	11	9.7		166	28	12	2.8	163	27	352	7.8
Sugar Creek near Ossian, N. Y. (Ont. 117-66-28)	2247	42°30'52"	77°48'12"	do.	.2	9-16-64 (1035)	53	.16	30	7.5	8.3		109	22	7.8	.8	106	16	242	7.4
Stony Brook at South Dansville, N. Y. (Ont. 117-66-25)	2248	42°28'14"	77°39'10"	Steuben	.06	9-16-64 (1305)	59	.08	41	10	6.2		143	34	3.2	.5	144	27	298	7.7
Sponable Creek near South Dansville, N. Y. (Ont. 117-66-25-3)	2248.1	42°30'04"	77°37'58"	do.	.05	9-16-64 (1345)	57	.04	38	6.6	4.6		132	21	1.4	.2	122	14	269	7.5
Stony Brook near Stony Brook Glen, N. Y. (Ont. 117-66-25)	2248.5	42°31'38"	77°41'45"	do.	2-3 (estimated)	9-16-64 (1540)	57	.02	46	13	5.1		162	39	4.0	.3	168	35	379	8.1
Mill Creek at Patchinville, N. Y. (Ont. 117-66-22)	2249	42°31'13"	77°35'06"	do.	1.7	9-16-64 (1220)	51	.06	49	12	5.3		169	26	11	3.4	172	34	369	7.8
Little Mill Creek near Dansville, N. Y. (Ont. 117-66-22-1)	2249.6	42°32'43"	77°40'43"	Livingston	.2-.4 (estimated)	9-16-64 (1515)	57	.08	50	22	1.2		197	39	12	.7	217	56	417	7.9

Table A-5.--Chemical analyses of streams in the Genesee River basin during low flows, 1964 and 1965 (Continued)

Name of site (stream number)	Site number (4-)	Latitude (north)	Longitude (west)	County	Discharge of stream at time of sampling (cfs)	Date of collection (time)	Temperature (°F)	Iron (Fe)	Calcium (Ca)	Magnesium (Mg)	As Na (calculated)		Bicarbonate (HCO_3)	Sulfate (SO_4)	Chloride (Cl)	Nitrate (NO_3)	Hardness as $CaCO_3$		Specific conductance (micromhos at 25°C)	pH
											Sodium (Na)	Potassium (K)					Calcium, magnesium	Noncarbonate		
								(Chemical determinations expressed in parts per million)												
Bradner Creek at Woodsville, N. Y. (Ont. 117-66-8)	2256	42°34'49"	77°44'20"	Livingston	0.9	9-16-64 (1440)	56	0.06	41	13	9.4		154	27	15	2.0	156	30	339	8.0
Keshequa Creek at Dalton, N. Y. (Ont. 117-66-3)	2258.5	42°32'15"	77°57'35"	do.	.05-.1 (estimated)	10- 2-64 (0955)	56	.02	66	16	12		214	70	6.0	.0	232	56	473	7.8
Newville Creek near Barkertown, N. Y. (Ont. 117-66-3-25)	2259	42°33'25"	77°55'32"	do.	.6-1 (estimated)	10- 2-64 (1010)	56	.11	57	17	10		223	35	11	.9	212	30	428	8.2
Keshequa Creek at Craig Colony, Sonyea, N. Y. (Ont. 117-66-3)	2260	42°40'53"	77°49'45"	do.	1.6	10- 2-64 (0915)	58	.13	47	18	16		152	70	20	.1	190	66	432	8.1
Buck Run Creek near Mount Morris, N. Y. (Ont. 117-66-1-1)	2267	42°41'26"	77°53'11"	do.	.001 (estimated)	10- 1-64 (1120)	49	.09	150	48	54		145	432	84	.0	571	452	1,260	7.5
Beards Creek near Leicester, N. Y. (Ont. 117-60)	2275.5	42°46'28"	77°54'52"	do.	.005 (estimated)	9-30-64 (1535)	50	.78	115	53	75		344	80	214	.0	505	223	1,290	7.8
Little Beards Creek tributary near Leicester, N. Y. (Ont. 117-60-2-1-1)	2275.7	42°48'05"	77°54'55"	do.	.002-.003 (estimated)	10- 1-64 (1215)	48	.05	72	33	42		244	72	92	.1	315	114	788	7.7
Bidwells Creek near Retsof, N. Y. (Ont. 117-53)	2276.55	42°50'44"	77°54'14"	do.	.01-.02 (estimated)	10- 1-64 (1310)	51	.11	118	30	47		354	92	86	16	418	128	990	7.6
Bairds Creek at The Forks, N. Y. (Ont. 117-53-2)	2276.57	42°51'07"	77°53'15"	do.	.007-.01 (estimated)	10- 1-64 (1345)	55	.05	225	61	335		456	70	772	9.0	815	441	3,020	7.6
Salt Creek near Retsof, N. Y. (Ont. 117-53)	2276.59	42°51'11"	77°51'20"	do.	.3-.6 (estimated)	10- 1-64 (1410)	64	.08	346	77	6,370		16 (CO_3 49)	255	10,400	5.0	1,180	1,080	26,500	9.5
Genesee River tributary near Fraser, N. Y. (Ont. 117-45)	2278.5	42°54'14"	77°52'30"	do.	.03-.04 (estimated)	10- 1-64 (1520)	55	.13	75	29	34		305	54	52	.6	307	56	698	7.8
Christie Creek near Caledonia, N. Y. (Ont. 117-42)	2278.9	42°55'54"	77°49'40"	do.	.05 (estimated)	11- 3-65 (1650)	46	--	--	--	--		316	58	38	3.2	344	84	711	7.8
Christie Creek near Canawaugus, N. Y. (Ont. 117-42)	2279	42°54'40"	77°47'19"	do.	.3 (estimated)	10- 1-64 (1550)	63	.63	96	44	92		296	94	187	16	419	176	1,200	7.7
Conesus Inlet at Scottsburg, N. Y. (Ont. 117-40-P67-10)	2279.4	42°40'08"	77°42'47"	do.	.01-.04 (estimated)	10- 2-64 (1105)	60	.03	99	27	17		274	135	22	.4	360	135	710	7.7
North McMillan Creek near Union Corners, N. Y. (Ont. 117-40-P67-9)	2279.6	42°43'55"	77°41'12"	do.	.1-.3	10- 2-64 (1145)	67	.03	72	22	9.2		265	53	14	.2	272	54	529	8.2
Conesus Creek at Lakeville, N. Y. (Ont. 117-40)	2279.95	42°50'10"	77°42'22"	do.	3.0 (9-29-64)	10- 1-64 (1810)	63	.07	35	10	12		121	29	19	.8	130	31	310	7.4
Little Conesus Creek near Littleville, N. Y. (Ont. 117-40-1)	2283.5	42°53'56"	77°45'19"	do.	.02 (estimated)	10- 1-64 (1745)	54	.05	107	34	26		419	60	41	.3	408	64	814	7.8
White Creek at Canawaugus, N. Y. (Ont. 117-34)	2285.2	42°55'53"	77°46'51"	do.	1.4	10- 1-64 (1610)	58	.08	93	28	13		288	85	31	11	350	114	692	7.8

Table A-5.--Chemical analyses of streams in the Genesee River basin during low flows, 1964 and 1965 (Continued)

Name of site (stream number)	Site number (4-)	Latitude (north)	Longitude (west)	County	Discharge of stream at time of sampling (cfs)	Date of collection (time)	Temperature (°F)	Iron (Fe)	Calcium (Ca)	Magnesium (Mg)	As Na (calculated)		Bicarbonate (HCO_3)	Sulfate (SO_4)	Chloride (Cl)	Nitrate (NO_3)	Hardness as $CaCO_3$		Specific conductance (micromhos at 25°C)	pH
											Sodium (Na)	Potassium (K)					Calcium, magnesium	Noncarbonate		
								(Chemical determinations expressed in parts per million)												
Dugan Creek at Maxwell, N. Y. (Ont. 117-28)	2285.5	42°58'25"	77°46'22"	Livingston	1.3	10- 1-64 (1635)	56	0.09	359	40	0.7		181	830	34	0.3	1,060	911	1,710	7.7
Briggs Gully Creek near Willow Beach, N. Y. (Ont. 117-27-P57-9a)	2288.43	42°43'22"	77°30'07"	Ontario	.01-.02 (estimated)	10- 2-64 (1420)	58	.04	36	9.7	6.9		106	39	12	.6	130	43	289	7.3
Mill Creek at Honeoye Park, N. Y. (Ont. 117-27-46)	2288.55	42°47'09"	77°29'57"	do.	.8	10- 2-64 (1445)	60	.02	53	16	10		204 (CO_3 2)	35	7.5	.4	196	26	395	8.3
Springwater Creek at Springwater, N. Y. (Ont. 117-27-34-P44-7)	2289	42°38'37"	77°36'12"	Livingston	.8	10- 2-64 (1245)	61	.06	54	14	14		194	35	20	1.1	194	35	427	7.7
Bebee Creek at Idaho, N. Y. (Ont. 117-27-28)	2293.3	42°51'38"	77°32'18"	Ontario	.05	10- 2-64 (1515)	66	.32	81	38	12		327	102	4.8	.7	357	88	670	7.8
Spring Brook at Moran Corner, N. Y. (Ont. 117-27-14)	2297	42°57'36	77°37'11"	Monroe	.3 (10- 2-64)	10- 5-64 (0750)	51	--	104	31	9.0		294	131	19	.7	386	145	728	7.6
Honeoye Creek tributary near Rush, N. Y. (Ont. 117-27-4)	2300.5	42°59'09"	77°39'54"	do.	.8 (10- 2-64)	10- 3-64 (1850)	--	.18	336	83	3.7		256	910	21	.2	1,180	970	1,820	7.7
Warner Creek at Rock Glen N. Y. (Ont. 117-25-70)	2303.1	42°41'04"	78°06'05"	Wyoming	.1 (9-19-64)	9-18-64 (1325)	58	.05	38	8.0	6.7		123	29	8.0	.9	128	27	274	7.6
Relyea Creek near Warsaw, N. Y. (Ont. 117-25-60)	2303.45	42°42'23"	78°11'13"	do.	.01-.02 (estimated)	9-18-64 (1355)	61	.14	54	12	10		213	20	8.6	.9	186	12	378	8.0
Oatka Creek tributary at South Warsaw, N. Y. (Ont. 117-25-59c)	2303.5	42°43'04"	78°07'58"	do.	.09 (9-19-64)	9-18-64 (1600)	61	--	36	13	6.4		134 (CO_3 4)	25	10	.9	143	26	296	8.4
South Branch Stony Creek near Halls Corners, N. Y. (Ont. 117-25-57-2)	2303.55	42°43'48"	78°12'07"	do.	.02-.05 (estimated)	9-18-64 (1420)	69	.08	36	16	6.9		158	36	2.5	.7	156	26	311	8.0
Stony Creek at Warsaw, N. Y. (Ont. 117-25-57)	2303.6	42°44'00"	78°08'16"	do.	.02 (9-19-64)	9-18-64 (1535)	62	.13	50	11	16		145	44	29	1.3	172	53	402	7.9
Oatka Creek tributary near Warsaw, N. Y. (Ont. 117-25-56a)	2303.65	42°44'14"	78°09'44"	do.	.01-.03 (estimated)	9-18-64 (1450)	61	.05	68	17	18		263	30	23	.3	240	24	507	8.0
Pearl Creek tributary near Lagrange, N. Y. (Ont. 117-25-20-2-3-a)	2303.9	42°48'50"	78°01'56"	do.	.002	9-19-64 (1025)	56	.83	110	31	9.9		455	30	13	.7	402	28	735	7.8
Pearl Creek at Pearl Creek, N. Y. (Ont. 117-25-20)	2304.1	42°50'55"	78°02'36"	do.	.09 (9-18-64)	9-19-64 (1050)	59	.05	89	23	11		180	132	28	19	316	168	667	6.8
East Fork Spring Brook at Caledonia, N. Y. (Ont. 117-25-4)	2304.85	42°58'29"	77°51'23"	Livingston	5-7 (estimated)	8-12-64 (0940)	49.5	.12	233	2.7	63		252	446	40	2.8	593	386	1,240	7.4
Genesee River tributary near Industry, N. Y. (Ont. 117-24a)	2305.5	43°01'36"	77°42'53"	Monroe	<.05 (estimated)	11- 3-65 (1545)	49	--	--	--	--		306	468	38	1.0	789	537	1,370	7.7
Black Creek near Bethany Center, N. Y. (Ont. 117-19)	2306.6	42°52'53"	78°07'17"	Genesee	.002 (estimated)	9-19-64 (1135)	60	.45	74	20	23		308	33	21	.9	268	15	576	8.0

Table A-5.--*Chemical analyses of streams in the Genesee River basin during low flows, 1964 and 1965* (Continued)

Name of site (stream number)	Site number (4-)	Latitude (north)	Longitude (west)	County	Discharge of stream at time of sampling (cfs)	Date of collection (time)	Temperature (°F)	Iron (Fe)	Calcium (Ca)	Magnesium (Mg)	As Na (calculated)		Bicarbonate (HCO_3)	Sulfate (SO_4)	Chloride (Cl)	Nitrate (NO_3)	Hardness as $CaCO_3$		Specific conductance (micromhos at 25°C)	pH
											Sodium (Na)	Potassium (K)					Calcium, magnesium	Noncarbonate		
								(Chemical determinations expressed in parts per million)												
Black Creek near Little Canada, N. Y. (Ont. 117-19)	2306.7	42°57'08"	78°05'15"	Genesee	0.05 (estimated)	10-20-65 (0945)	46	--	--	--	--		337	72	40	0.1	378	102	750	8.1
Black Creek near Morganville, N. Y. (Ont. 117-19)	2306.8	43°01'27"	78°05'01"	do.	.002 (estimated)	10-20-65 (0900)	49	--	--	--	--		380	55	94	.1	409	97	957	7.9
Bigelow Creek tributary near Batavia, N. Y. (Ont. 117-19-30-3)	2306.9	43°00'39"	78°08'01"	do.	.1-.3 (estimated)	9-19-64 (1335)	63	--	160	38	19		333	236	53	4.9	556	283	1,080	7.3
Bigelow Creek near South Byron, N. Y. (Ont. 117-19-30)	2307	43°02'56"	78°05'43"	do.	1 (estimated)	9-19-64 (1445)	69	0.33	73	31	16		152	156	41	.4	311	186	669	7.7
Spring Creek near Batavia, N. Y. (Ont. 117-19-28)	2307.4	43°02'40"	78°10'18"	do.	.02-.06 (estimated)	9-19-64 (1355)	68	.19	423	40	36		232	1,050	9.5	1.7	1,220	1,030	1,960	7.6
Spring Creek tributary near Batavia, N. Y. (Ont. 117-19-28-9-a)	2307.5	43°02'41"	78°09'20"	do.	.01-.03 (estimated)	9-19-64 (1420)	62	.30	108	32	2.8		312	134	5.2	4.7	401	145	716	7.7
Spring Creek at Pumpkin Hill N. Y. (Ont. 117-19-28)	2308	43°05'37"	78°04'00"	do.	2.0 (9-18-64)	9-19-64 (1515)	66	.16	402	33	36		214	960	29	1.6	1,140	965	1,890	7.5
Hotel Creek near Churchville, N. Y. (Ont. 117-19-9)	2310.5	43°05'08"	77°51'44"	Monroe	.7 (10- 2-64)	10- 5-64 (1535)	52	.11	388	90	166		276	1,020	26	6.8	1,340	1,110	2,020	7.4
Black Creek tributary near Churchville, N. Y. (Ont. 117-19-8)	2310.7	43°06'52"	77°50'35"	do.	.5 (estimated)	10-21-65 (1300)	60	--	--	--	--		285	70	51	17	344	110	762	8.0
Mill Creek near West Chili, N. Y. (Ont. 117-19-4)	2311	43°04'31"	77°46'56"	do.	2.5 (10- 2-64)	10- 5-64 (1555)	53	.12	456	46	9.4		226	1,050	50	.9	1,330	1,140	2,060	7.7
Little Black Creek tributary near North Chili, N. Y. (Ont. 117-18-5b)	2312.4	43°07'59"	77°44'10"	do.	.01-.02 (estimated)	10- 5-64 (1655)	52	.73	80	35	27		279	88	58	1.6	345	116	758	7.6
Little Black Creek near Coldwater, N. Y. (Ont. 117-18)	2312.6	43°07'50"	77°43'34"	do.	1.0-1.2 (estimated)	10-21-65 (1430)	58	--	--	--	--		318	70	59	.1	350	89	794	7.8
Red Creek at Henrietta Station, N. Y. (Ont. 117-14)	2313.2	43°03'31"	77°38'07"	do.	.5 (estimated)	10-21-65 (1540)	62	--	--	--	--		322	879	81	.2	1,250	986	2,080	7.8
Red Creek tributary at Fenner, N. Y. (Ont. 117-14-2-1)	2313.4	43°03'30"	77°39'47"	do.	.1 (estimated)	10-20-65 (1240)	57	--	--	--	--		272	1,120	18	.0	1,440	1,220	2,150	7.9
Red Creek tributary near Rochester, N. Y. (Ont. 117-14-2-1)	2313.6	43°04'21"	77°38'53"	do.	.01-.02 (estimated)	10- 5-64 (1750)	49	.40	449	43	9.0		231	1,050	25	.4	1,300	1,110	2,000	7.7

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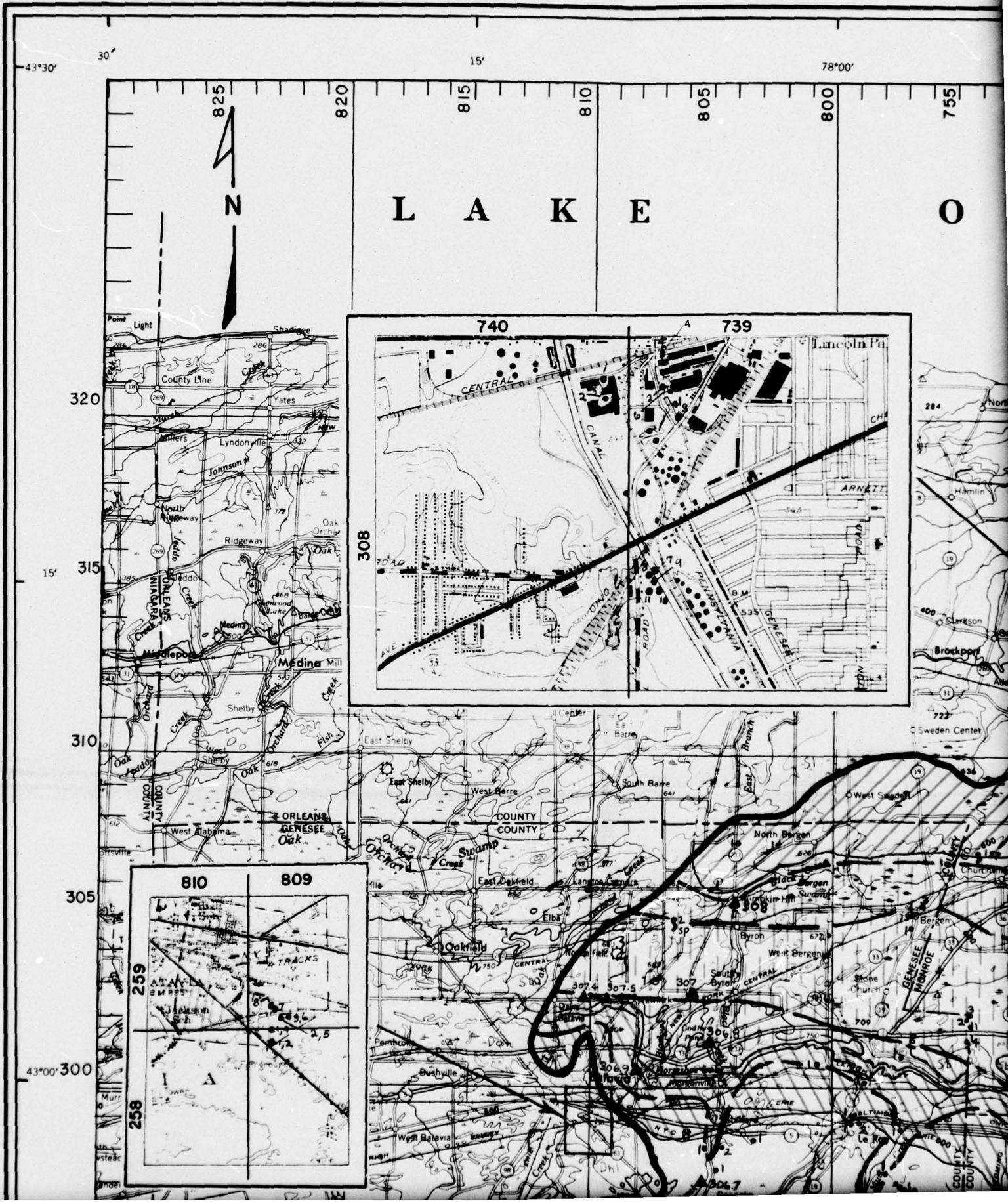
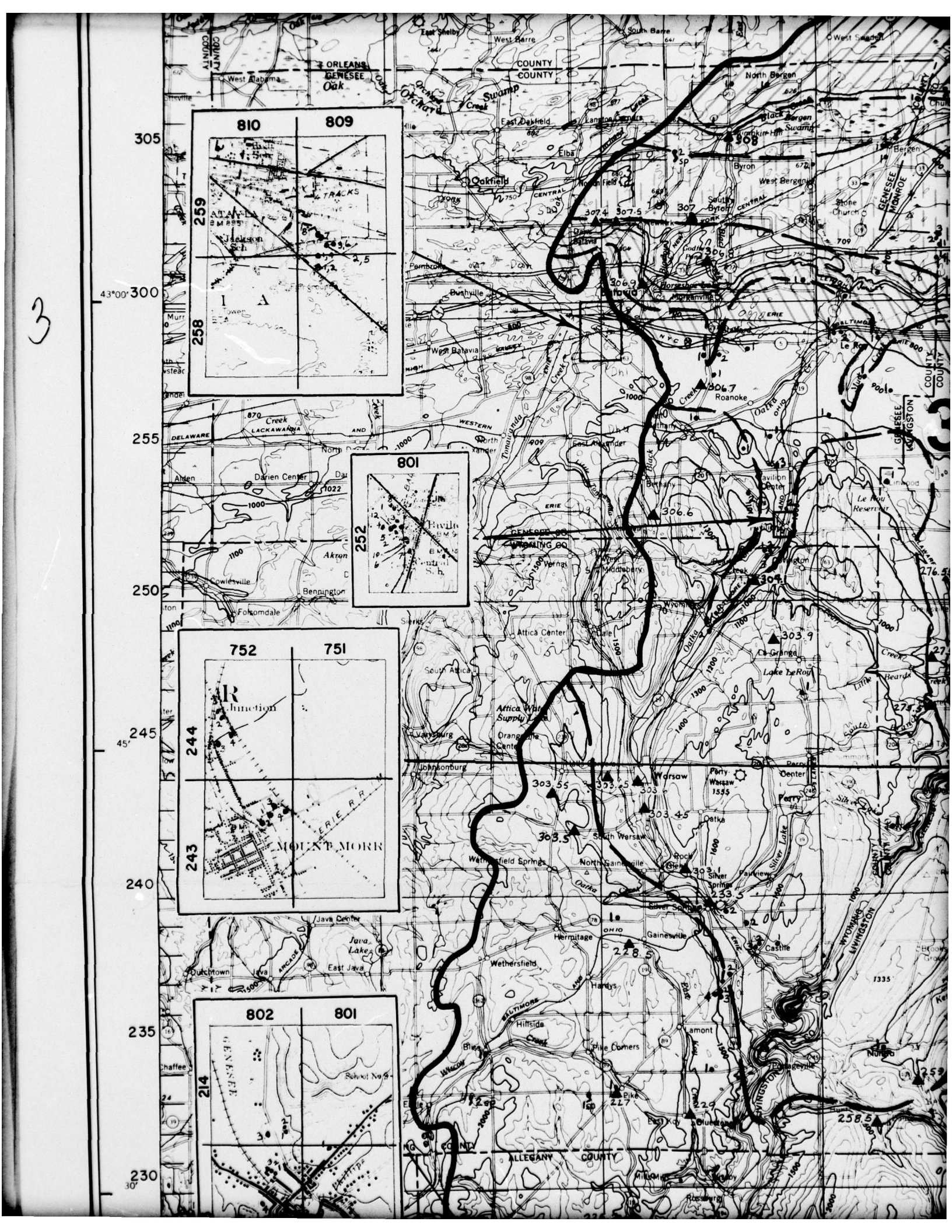


2

Appendix I
Plate 1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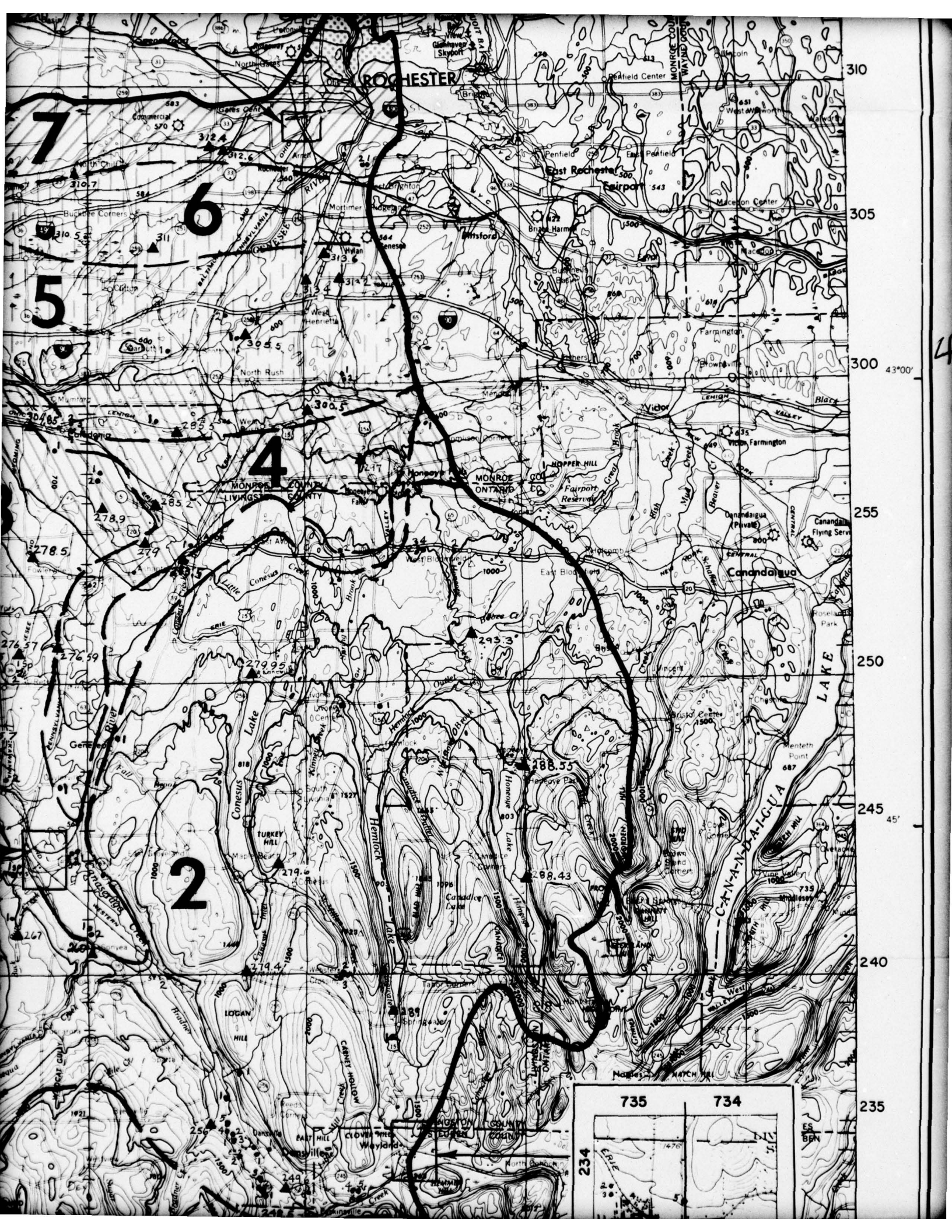
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Penfield
Pittsford
Brighton
Mortimer
Henrietta
Honeoye
Victor
Farmington
Canandaigua
Naples
Dansville
Geneseo
Conesus Lake
Honeoye Lake
Canadice Lake
Hemlock Lake
CANANDAIGUA LAKE
MONROE COUNTY
ONTARIO
LIVINGSTON
ALLEGANY
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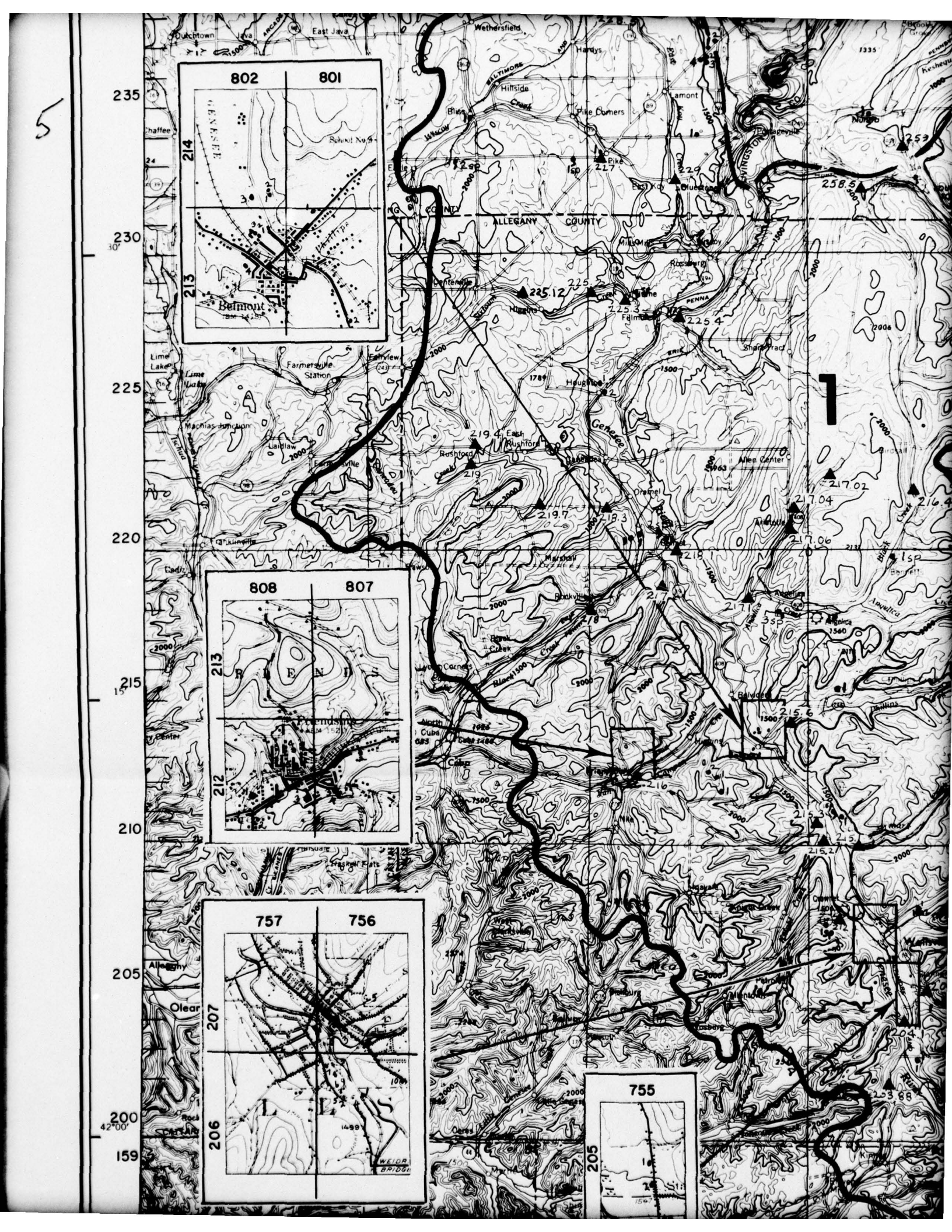
802
801
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Belmont
GENESEE
ALLEGANY COUNTY
808
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Fillmore
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Olean
755
205
Wethersfield
Hillside
Bliss
Pike Corners
Pike
Lamont
Bluestone
Centerville
Rossburg
Fillmore
Lime Lake
Farmersville Station
Fairview
Machias Junction
Laidlaw
Rushford
East Rushford
Genesee
Dromel
Allen Center
Angelica
Belvidere
Cuba
Hinsdale
Olean
Allegany
Weldon Bridge
Wellsville
Andover
Petrolia
Alfred
Almond
Kirkpatrick
Genesee
Allegheny
Canaseraga
Oramel
Marshall
Rockville
Black
Brook
Creek
Hughes
Nike
Mt Hope
Oerra
Martha
Lyons Corners
North Cuba
Cuba Lake
Farmers Valley
Crosby
Shire Tract
Haskell
Hughes
Gillmans
Kirkpatrick
Hanover
Crawford
Hayes
Ward
Wells
Hall
Bell
Ellis
Rock
Chaffee
Java
East Java
Dutchtown
Hardys
Baltimore
Creek
Kanakadea
Creek
Pennsylvania
Penna
Railroad
Erie
Railroad
Lehigh
Valley
Railroad
Genesee
River
Allegheny
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Canaseraga
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Vandalia
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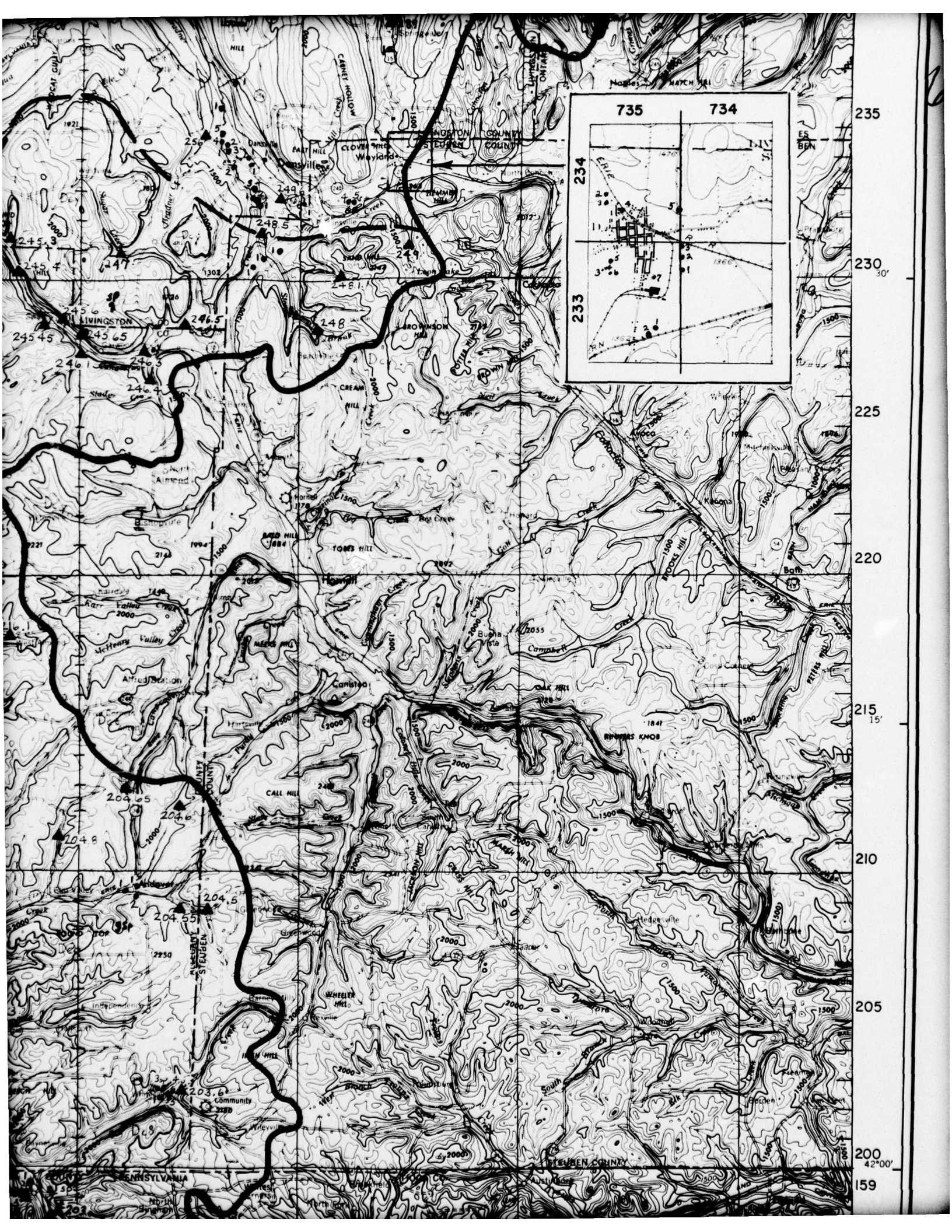
735
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LIVINGSTON COUNTY
STEUBEN COUNTY
ALLEGANY COUNTY
PENNSYLVANIA
Dansville
Wayland
Avoca
Bath
Hornell
Canisteo
Arkport
Hedgeville
Wheeler Hill
Community
Howard
Kanona
Cameron
Buena Vista
Bradford
Troupsburg
Greenwood
Jasper
Rexville
Independence
Almond
Alfred Station
Bishopville
Andover
Whitesville
Genesee
Fremont
Erie
Lackawanna
Lehigh Valley
Pennsylvania
Chicago
Northern Central
Baltimore & Ohio
Delaware, Lackawanna & Western
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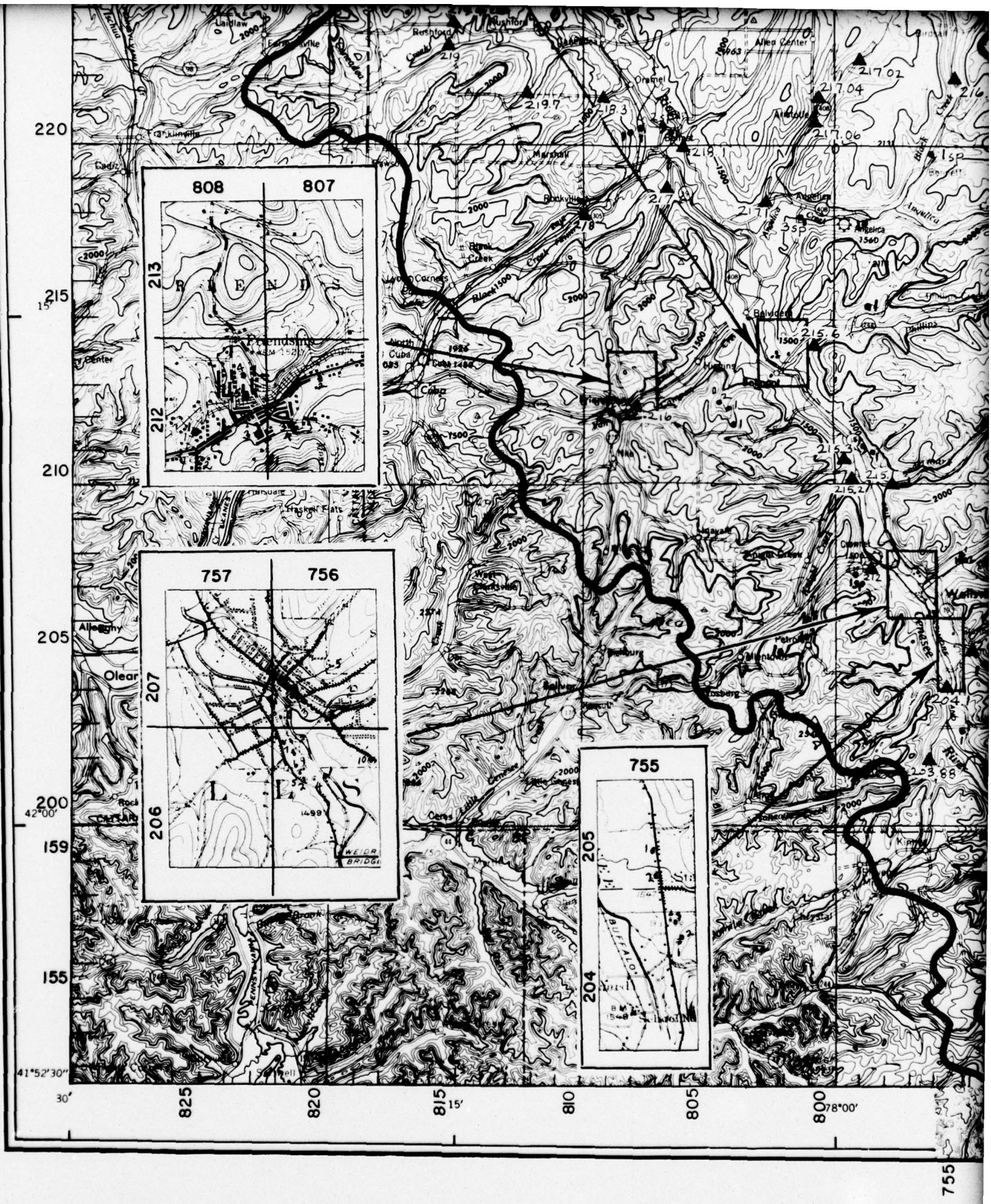
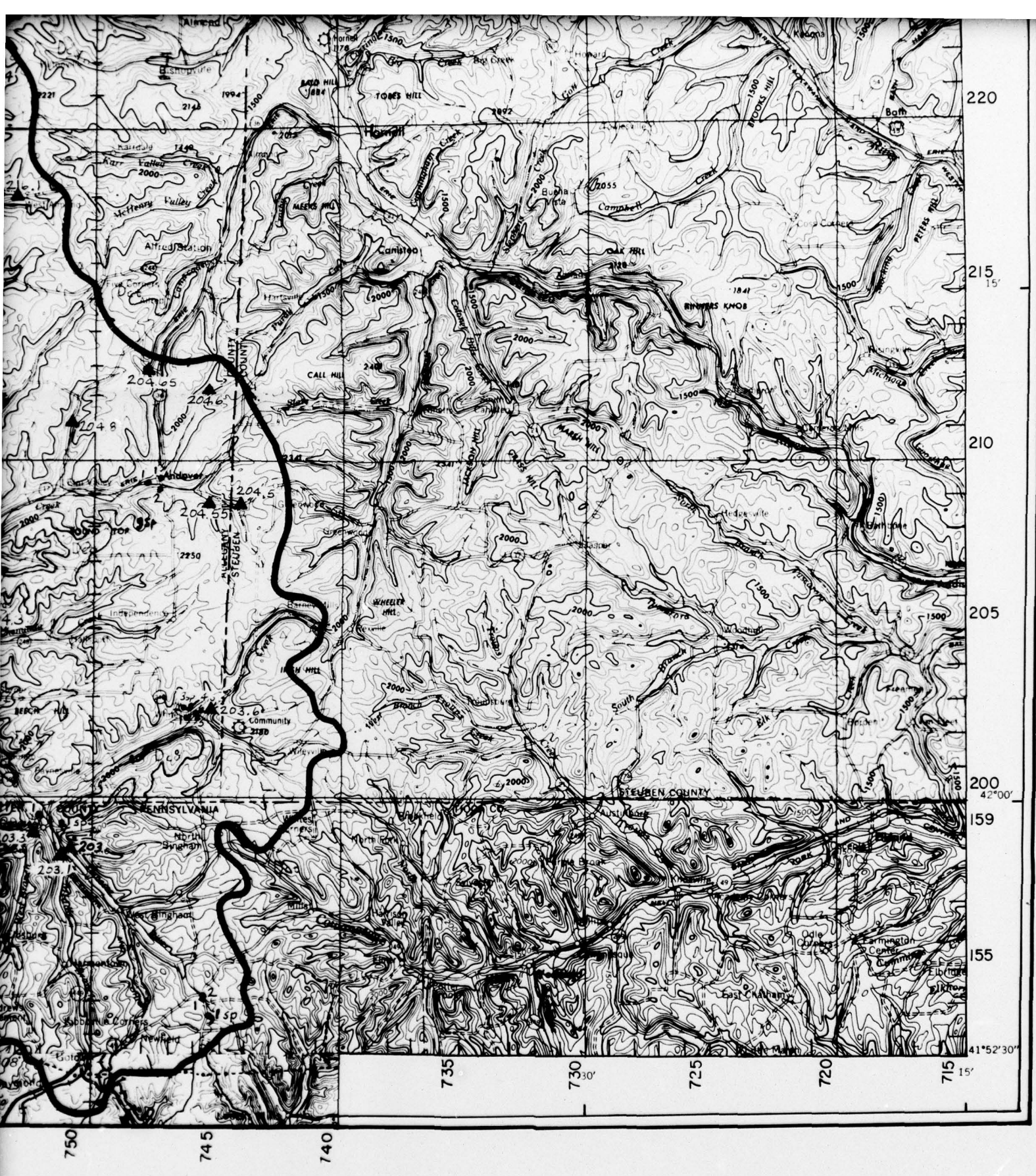
Lehigh Valley
Pennsylvania
Chicago
Northern Central
Baltimore & Ohio
Delaware, Lackawanna & Western
Erie
Lackawanna



Map of hydrologic units of the bedrock, water-quality

Genesee Riv



zones, and location of selected wells and springs in the

r basin, N.Y. - PA.

EXPLANATION

2●

or test hole (identified by
t digit of number; latitude
d longitude numbers on
margin of map).

▲311

am-sampling site (at base flow);
complete form of each number is
eceded by 4-2, such as 4-2311.
emical analyses for these sites
are in appendix table A-5.

1sp
Spring

6 7
Boundary of water-quality zones

Water-bearing characteristics of bedrock

per shale-sandstone unit, including some thin limestones
ear base. Yields to 4 of 5 individual wells, 2-40 gpm;
dissolved solids, 160-520 ppm;
hardness, 54-340 ppm.

Limestone-dolomite unit, including dolomitic shale.
Yields to 4 of 5 individual wells, 5-160 gpm;
dissolved solids, 320-750 ppm;
hardness, 240-550 ppm.

Gypsum-shale unit, including some dolomite yields to
4 of 5 individual wells, 18-42 gpm;
dissolved solids, 510-2,000 ppm;
hardness, 380-1,500 ppm.

Dolomite unit, including some limestone. Yields to
4 of 5 individual wells, 10-190 gpm;
dissolved solids, 330-540 ppm;
hardness, 260-500 ppm.

EXPLANATION

2● Well or test hole (identified by last digit of number; latitude and longitude numbers on margin of map).

1sp ● Spring

▲311 Stream-sampling site (at base flow); the complete form of each number is preceded by 4-2, such as 4-2311. Chemical analyses for these sites are in appendix table A-5.

6 — 7 Boundary of water-quality zones

Water-bearing characteristics of bedrock

Upper shale-sandstone unit, including some thin limestones near base. Yields to 4 of 5 individual wells, 2-40 gpm; dissolved solids, 160-520 ppm; hardness, 54-340 ppm.

Limestone-dolomite unit, including dolomitic shale. Yields to 4 of 5 individual wells, 5-160 gpm; dissolved solids, 320-750 ppm; hardness, 240-550 ppm.

Gypsum-shale unit, including some dolomite yields to 4 of 5 individual wells, 18-42 gpm; dissolved solids, 510-2,000 ppm; hardness, 380-1,500 ppm.

4

Dolomite unit, including some limestone. Yields to 4 of 5 individual wells, 10-190 gpm; dissolved solids, 330-540 ppm; hardness, 260-500 ppm.

Gypsum-shale unit, including some dolomite yields to 4 of 5 individual wells, 18-42 gpm; dissolved solids, 510-2,000 ppm; hardness, 380-1,500 ppm.

Dolomite unit, including some limestone. Yields to 4 of 5 individual wells, 10-190 gpm; dissolved solids, 330-540 ppm; hardness, 260-500 ppm.

Lower shale-sandstone unit, predominantly shale, especially the lower 1,000 feet; a few feet of limestone at top of unit. Very little data; yields probably less than 10 gpm.

Water-bearing bedrock units

Upper shale-sandstone unit

Conewango Group
Conneaut Group
Canadaway Group
Java and West Falls Groups
Sonyea Group
Genesee Group
Moscow and Ludlowville Formations
Skaneateles and Marcellus Formations

Limestone-dolomite unit

Onondaga Limestone
Akron Dolomite and Bertie Group

Gypsum-shale unit

Salina Group (principally Camillus Shale)

Genesee Group
Moscow and Ludlowville Formations
Skaneateles and Marcellus Formations

Limestone-dolomite unit

Onondaga Limestone
Akron Dolomite and Bertie Group

Gypsum-shale unit

Salina Group (principally Camillus Shale)

Dolomite unit

Lockport Group

Lower shale-sandstone unit

Decew Dolomite and Rochester Shale
Irondequoit Limestone; Williamson Shale; Sodus Shale; Reynales Limestone; Maplewood Shale; Kodak Sandstone

Medina Group
Queenston Formation

Water-quality zones of shallow ground water

	SO_4 (ppm)	Hardness as $CaCO_3$	Dissolved solids (ppm)
Zone 1	<50	<200	<300
2	<50	200-400	300-500
3	50-100	300-500	300-1,000
4	100-500	300-500	300-1,000
5	usually 500-1,200	300-1,400	400-1,500
6	100-500	300-1,400	400-1,500
7	<100	200-400	300-500

Geologic contacts and symbols from New York State geologic map of 1961 (Broughton and others, 1962), Finger Lakes and Niagara quadrangles.

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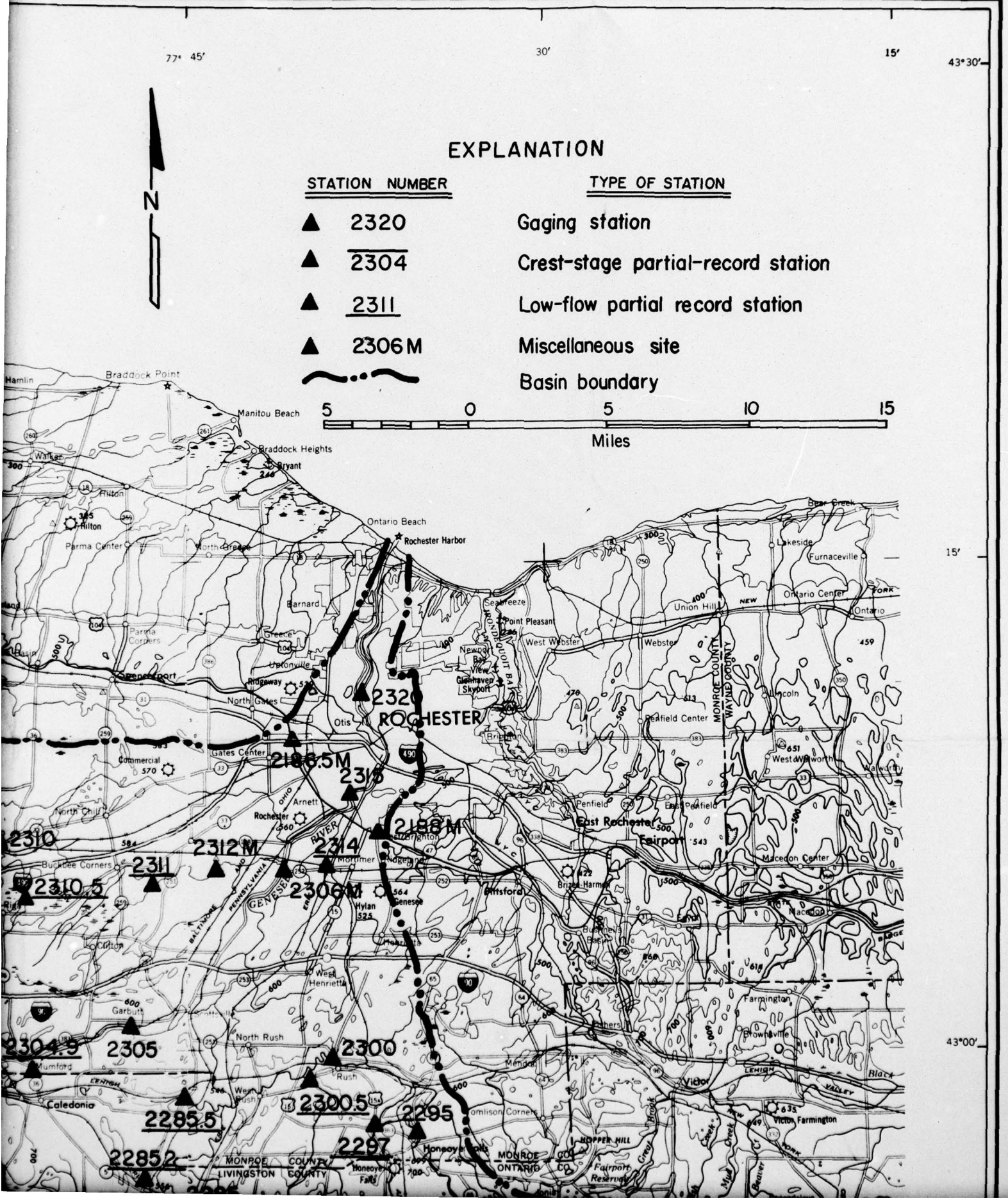
77° 45′
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EXPLANATION
STATION NUMBER
TYPE OF STATION
2320
Gaging station
2304
Crest-stage partial-record station
2311
Low-flow partial record station
2306M
Miscellaneous site
Basin boundary
N
5 0 5 10 15
Miles
Braddock Point
Hamlin
Manitou Beach
Braddock Heights
Bryant
Walker
Hilton
Parma Center
Ontario Beach
Rochester Harbor
Barnard
Greece
Parma Corners
Spencerport
Ogden
Ridgeway
North Gates
Otis
ROCHESTER
Gates Center
Commercial
Arnett
Rochester
North Chili
Buckbee Corners
Clifton
West Henrietta
Garbutt
North Rush
Mumford
Caledonia
Rush
Honeoye Falls
Tomlison Corners
Seabreeze
Point Pleasant
Newport Bay
View
Clearwater
Skyport
West Webster
Webster
Union Hill
Penfield
Penfield Center
Briarwood
Brighton
Mortimer
Hudson
Pittsford
Hylan
Genesee
Brizee Harmon
East Rochester
Fairport
Macedon Center
Macedon
Bushnell's Basin
Farmington
Brownsville
Victor
Victor Farmington
Lakeside
Furnaceville
Ontario Center
Ontario
Lincoln
Westbury
Wallworth
Bear Creek
MONROE COUNTY
WAYNE COUNTY
MONROE COUNTY
LIVINGSTON COUNTY
MONROE COUNTY
ONTARIO CO.
Fairport Reservoir
HOPPER HILL
2320
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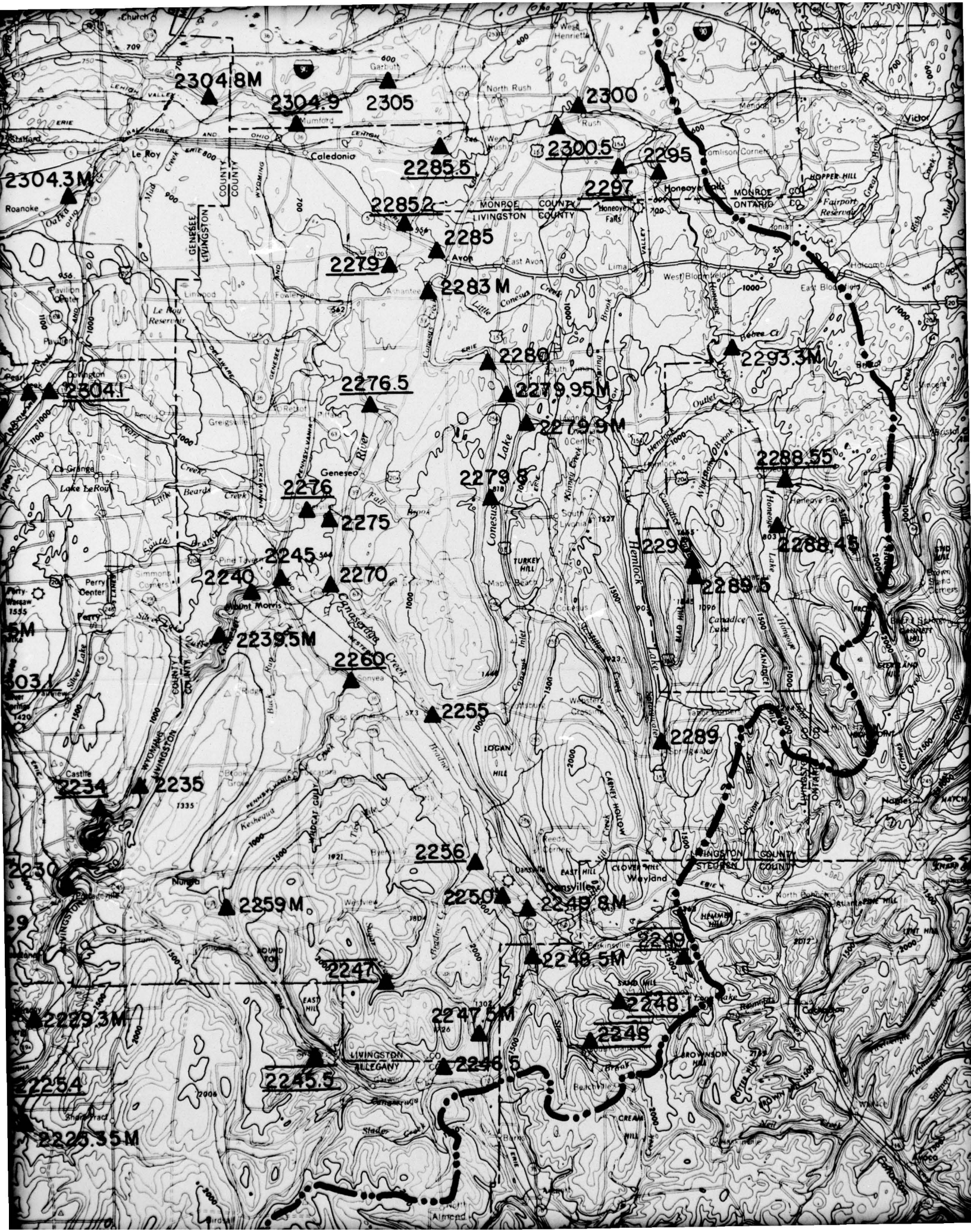
Roanoke
Bethany
Pavilion Center
Le Roy Reservoir
Akron Reservoir
Attica
Darien Center
Alexander
Batavia
Cowlesville
Bennington
Folsomdale
Darien City
North Darien
East Alexander
Pavilion
Oatka Creek
Lake LeRoy
Attica Center
South Attica
Harris Corners
Person Corners
Warsaw
Orangeville Center
Halls Corners
Johnsonburg
Perry Center
Perry-Warsaw 1555
Sheldon
Dutch Hollow
Strykersville
North Java
Java Village
Java Center
Java Lake
East Java
Dutchtown
Wethersfield Springs
North Gainesville
Silver Springs
Hermitage
Gainesville
Castile
Wethersfield
Hardys
Hillside
Bliss
Lake Corners
Lamont
Pike
East Koy
Bluestone
Portageville
East Arcade
Arcade
Arcade Center
Yorkshire
Delevan
Sandusky
Freedom
Centerville
Rossburg
Home
Fillmore
Elton
Lime Lake
Farmersville Station
Fairview
Machias Junction
Laidlaw
Rushford
East Rushford
Allen Center
Oramel
Rockville
Marshall
Franklinville
Ischua
Genesee
Tonawanda Creek
Little Tonawanda Creek
Buffalo Creek
Cattaraugus Creek
Silver Lake
Wiscoy Creek
Eighteenmile Creek
Ischua Creek
Caneadea Creek
Allen Creek
Pearl Creek
Spring Creek
Rock Creek
Penn Yan
Shipman Tract
Houghton
Mills Mills
Wiscoy
Fairview
Yorkshire
Lime Valley
Rushford Lake
Genesee County
Wyoming County
Allegany County
Cattaraugus County
Erie County
Wyoming County
Livingston County
Genesee
Wyoming
Livingston
Erie
Penna
Ohio
New York
Central
Lackawanna and Western
Erie
45'
30'


2304.8M
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2305
2300
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2295
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2279
2283 M
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2235
2259 M
2256
2250
2249.8M
2248.5M
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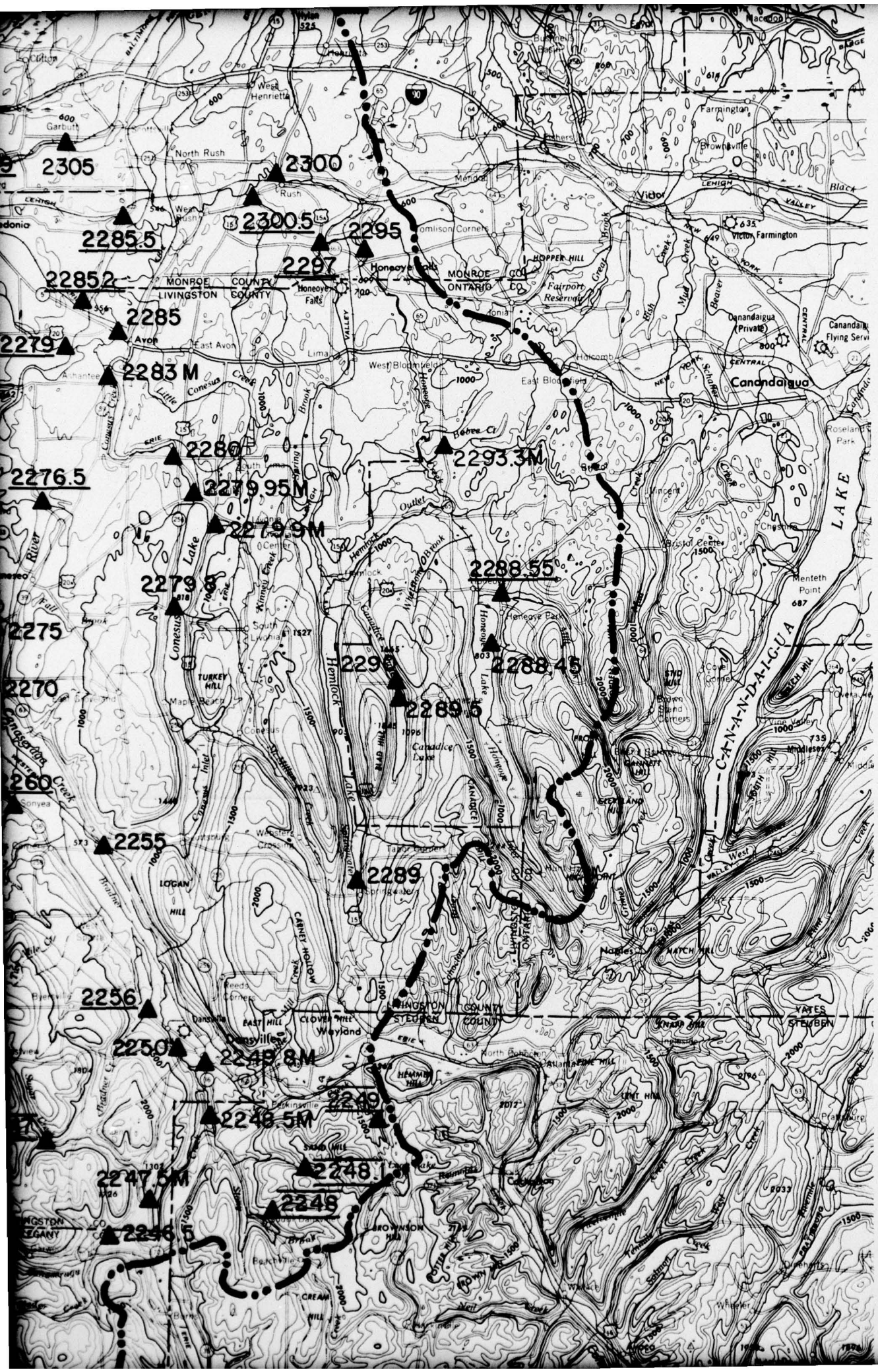
2248
2229.3M
2247.5M
2246.5
2245.5
2225.35M
Church
Henrietta
Garbutt
North Rush
Rush
Victor
Mumford
Caledonia
Le Roy
Honeoye Falls
Fairport
Reservoir
Roanoke
Avon
East Avon
Lima
West Bloomfield
Pavilion
Pavilion Center
Le Roy Reservoir
Conesus Creek
Livonia
Center
Geneseo
Lake LeRoy
Little Beards Creek
South Branch
Conesus Lake
Hemlock Lake
Canadice Lake
Honeoye Lake
Honeoye Falls
Perry
Perry Center
Mount Morris
Canaseraga Creek
Sonyea
Castle
Nunda
Dansville
Reeds Corners
Wayland
Clover Hill
Naples
Hopper Hill
Monroe County
Livingston County
Ontario County
Steuben County
Allegany County
Wyoming County
Genesee County
Pennsylvania
Erie
Lehigh Valley
Erie Canal
Turkey Hill
Logan Hill
Carney Hollow
Sand Hill
Cream Hill
Brownson Hill
Almond


2305
2300
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2295
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2275
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2296
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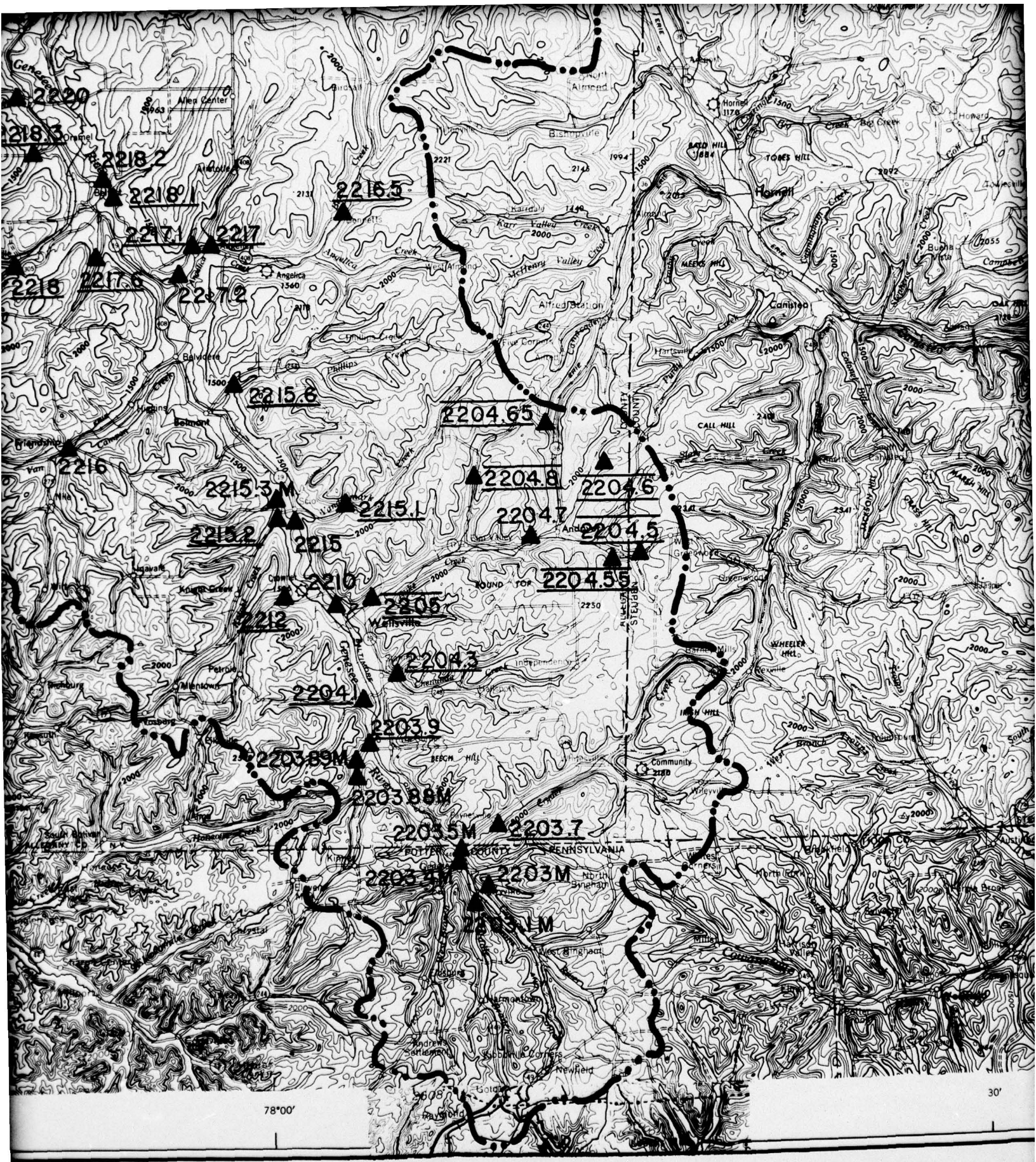
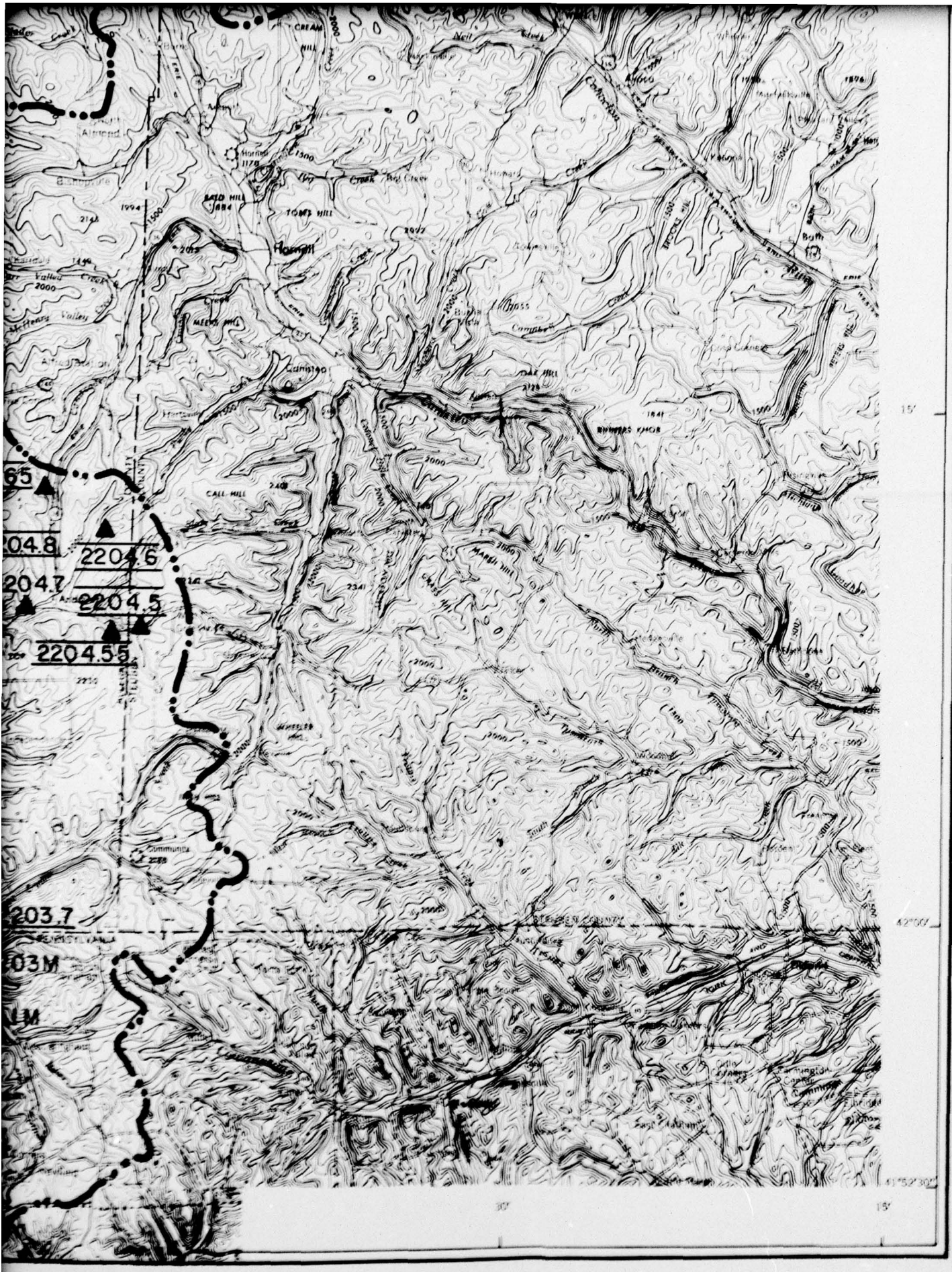
2270
2260
2255
2289
2256
2250
2249.8M
2249
2248.5M
2248.1
2247.5M
2248
2246.5
43°00'
45'
30'
Macedon
Farmington
Victor
Canandaigua
Honeoye Falls
MONROE COUNTY
LIVINGSTON COUNTY
ONTARIO CO.
Avon
East Avon
Lima
West Bloomfield
Honeoye
Bristol Center
Cheshire
Menteth Point
Naples
Dansville
Wayland
Perkinsville
Reeds Corners
Sonyea
Conesus Lake
Hemlock Lake
Canadice Lake
Honeoye Lake
Canandaigua Lake
C-A-N-A-N-D-A-I-G-U-A
LAKE
LIVINGSTON
STEUBEN
YATES

Map showing location of gaging stations, partial-record stations, and selecte



, partial-record stations, and selected miscellaneous measuring sites in the Ge


CREAM HILL
Almond
Hornell
1170
1300
BALD HILL
1484
TOWNS HILL
Hornell
Canisteo
Arkport
Hartsville
Valley
2000
Stephens Valley
Canisteo
Arkport
Canisteo
Canisteo
Neil
Creek
Big Creek
Canisteo
Canisteo
Canisteo

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GEOLOGICAL SURVEY, Albany, N.Y.

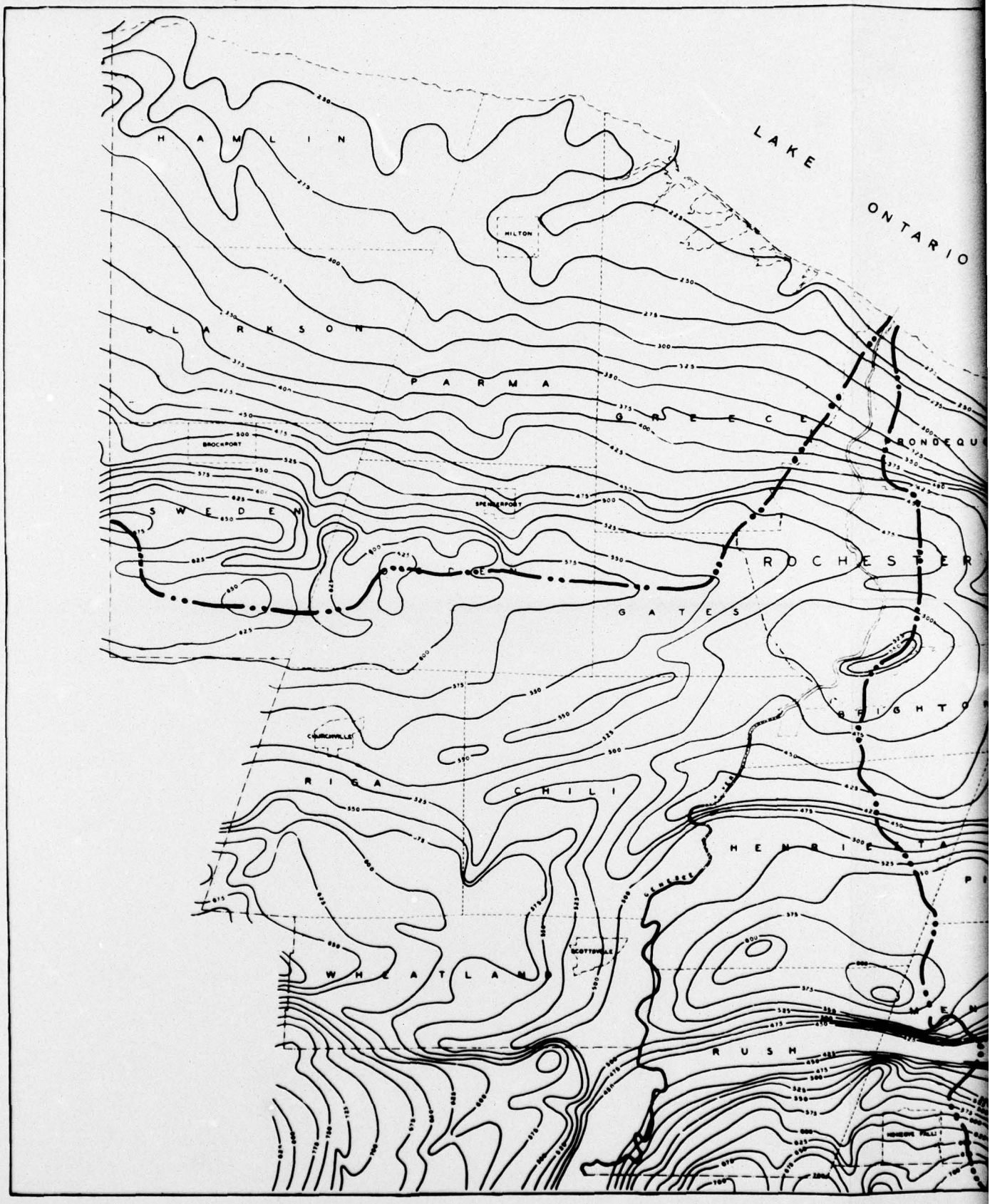
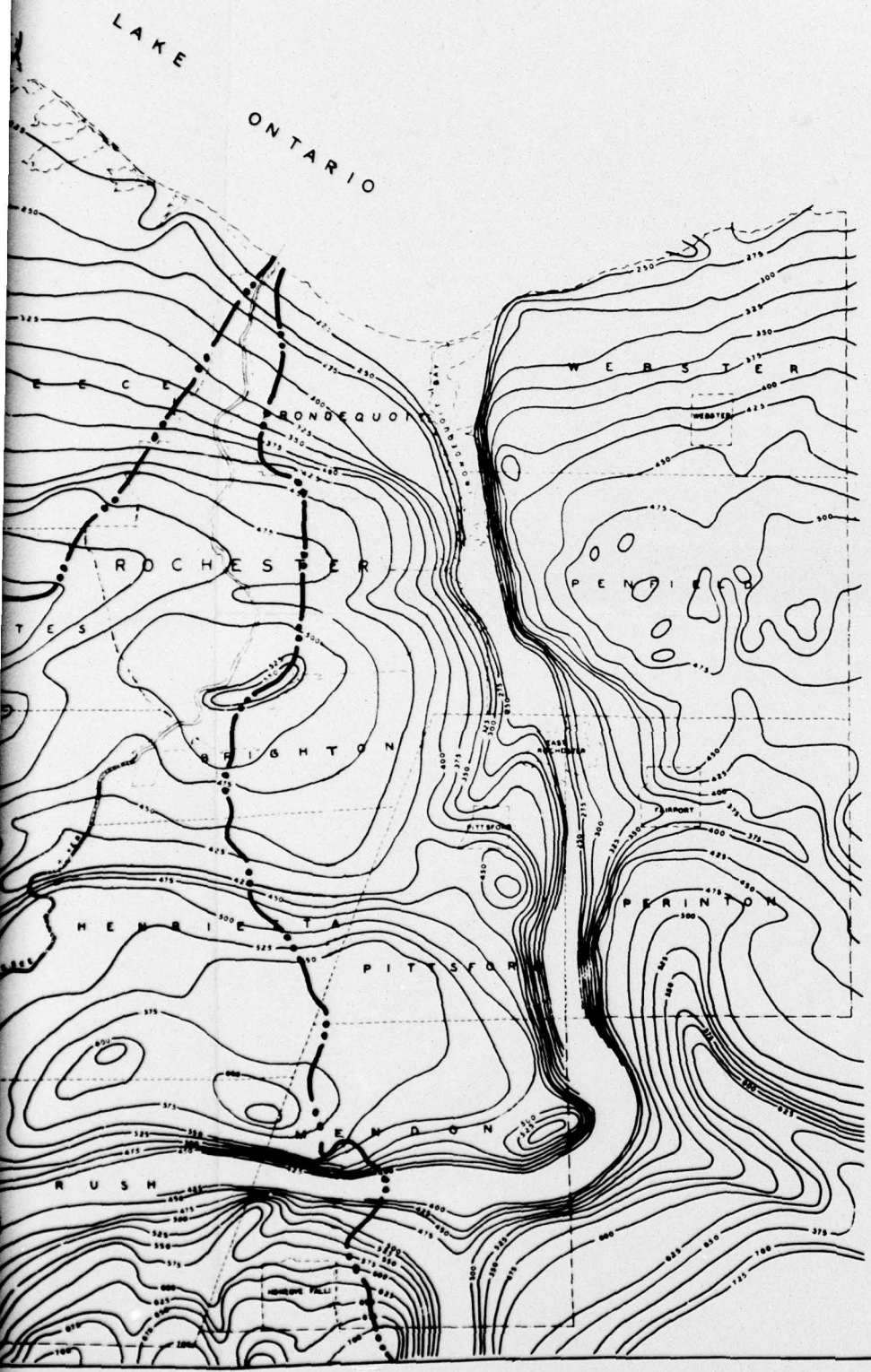


Figure 5. Bedrock contour map of Monroe County



BED-ROCK CONTOUR MAP
OF
MONROE COUNTY N.Y.

MONROE COUNTY REGIONAL PLANNING BOARD

—275—
BEDROCK CONTOUR
SHOWS ALTITUDE OF BEDROCK SURFACE

APPROXIMATE BOUNDARY OF
THE GENESEE RIVER BASIN

CONTOUR INTERVAL IS 25 FEET
DATUM IS MEAN SEA LEVEL

SCALE
0 1 2 3 4 5 6 MILES

N

contour map of Monroe County (from Leggette and others, 1935).

2

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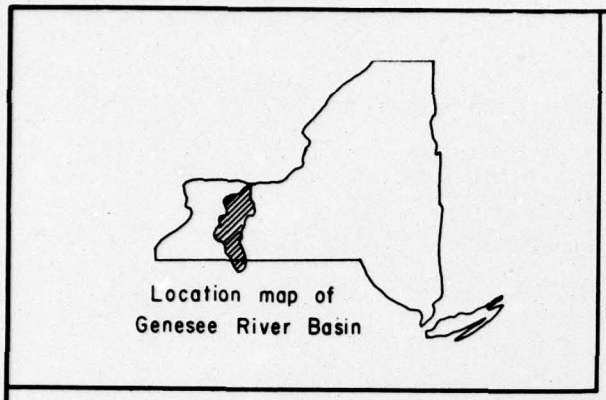
UNITED STATES DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY, Albany, N.Y.



78°00' 77°45' 77°30' 77°15'

43°00' 42°45' 42°30' 42°15'

LAKE ONTARIO
NEW YORK STATE
ROCHESTER
BARGE CANAL
GENESEE
MONROE
ONTARIO
WYOMING
LIVINGSTON
ALLEGANY
CATTARAUGUS
STEUBEN

BYRON
BERGEN
CHURCHVILLE
CLIFTON
SCOTTSVILLE
GARBUTT
HENRIETTA
WEST HENRIETTA
MORGANVILLE
BATAVIA
STAFFORD
LEROY
MUMFORD
CALEDONIA
RUSH
HONEOYE FALLS
EAST BETHANY
BETHANY
FOWLERVILLE
AVON
LIMA
WEST BLOOMFIELD
PAVILION
YORK
ASHANTEE
GRIEGSVILLE
LAKEVILLE
WYOMING
GENESEO
LIVONIA
HEMLOCK
HONEOYE
CONESUS LAKE
LEICESTER
Jones Bridge
HEMLOCK LAKE
WARSAW
PERRY
MOUNT MORRIS
CONESUS
SILVER LAKE
SILVER SPRINGS
CANADICE LAKE
HERMITAGE
GAINESVILLE
SONYEA
GROVELAND STATION
CASTILE
St Helena
SPRINGWATER
Letchworth State Park
AMONT
BLISS
PORTAGE
NUNDA
WAYLAND
PORTAGEVILLE
DANSVILLE
PIKE
HUNT
DALTON
PERKINSVILLE
ARCADE
MILLS MILLS
CENTERVILLE
ROSSBURG
SWAIN
SOUTH DANSVILLE
FILLMORE
CANASERAGA
HOUGHTON
SLADE CR
BIRDSALL
RUSHFORD CR
CANEADEA
BELFAST
ANGELICA
WEST ALMOND
BLACK CREEK
WHITE
BELVIDERE
PHILLIPS CREEK
ALFRED
FRIENDSHIP
BELMONT
NILE
SCIO
ANDOVER

EXPLANATION

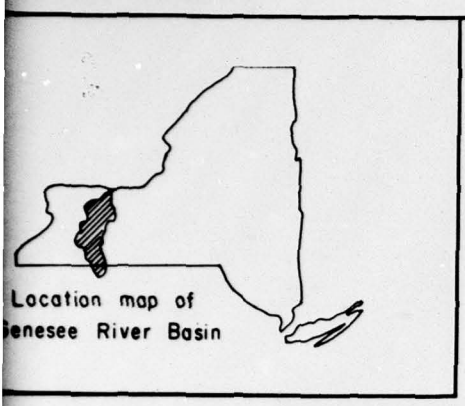
Coarse-grained stratified deposits, usua
or sand and gravel, principally of gla
origin. Such deposits yield 50 to 500
to individual, properly constructed we
in most of the areas shown by this sym

Surficial coarse-grained stratified depo
containing much silt and sometimes cla
to wells may be much less than 50 gpm.
beneath the silt, clay, and fine-grain
are one or more beds of sand and grave
5 and 30 feet in thickness in most are
will yield from 50 to several hundred
wells. In the deeper valleys where th
and gravel deposits occur, they may be
more than one or two hundred feet of f
grained materials.

Fine-grained stratified deposits, mainly
silt, and sometimes fine-grained sand.
yield little or no water to wells.

Prepared by
S DEPARTMENT OF THE INTERIOR
CAL SURVEY, Albany, N.Y.

Appendix 1
Plate 2



LAKE ONTARIO

NEW YORK STATE

ROCHESTER

GENESEE

WYOMING

LIVINGSTON

ONTARIO

ALLEGANY

STEUBEN

CATTARAUGUS

BARCADE

BATAVIA

BYRON

BERGEN

CHURCHVILLE

CLIFTON

HENRIETTA

WEST HENRIETTA

SCOTTSVILLE

GARBUTT

MORGANVILLE

STAFFORD

LEROY

MUMFORD

CALEDONIA

RUSH

HONEOYE FALLS

LIMA

WEST BLOOMFIELD

EAST BETHANY

BETHANY

FOWLERVILLE

AVON

ASHANTEE

PAVILION

YORK

GRIEGSVILLE

WYOMING

GENESEO

LAKEVILLE

LIVONIA

HEMLOCK

HONEOYE

CONESUS LAKE

HEMLOCK LAKE

HONEOYE LAKE

CONESUS

CANADICE LAKE

Jones Bridge

LEICESTER

WARSAW

PERRY

MOUNT MORRIS

SILVER LAKE

SILVER SPRINGS

HERMITAGE

GAINESVILLE

CASTILE

SONYEA

GROVELAND STATION

SPRINGWATER

St. Helena

Letchworth State Park

AMONT

BLISS

PORTAGEVILLE

PORTAGE

NUNDA

PIKE

HUNT

DALTON

WAYLAND

DANSVILLE

PERKINSVILLE

MILLS MILLS

CENTERVILLE

WISCOY

ROSSBURG

SWAIN

SOUTH DANSVILLE

FILLMORE

CANASERAGA

HOUGHTON

SLADE CR.

BIRDSALL

RUSHFORD

CANEADEA

BELFAST

ANGELICA

WEST ALMOND

BLACK CREEK

WHITE

BELVIDERE

PHILLIPS CREEK

ALFRED

FRIENDSHIP

BELMONT

NILE

SCIO

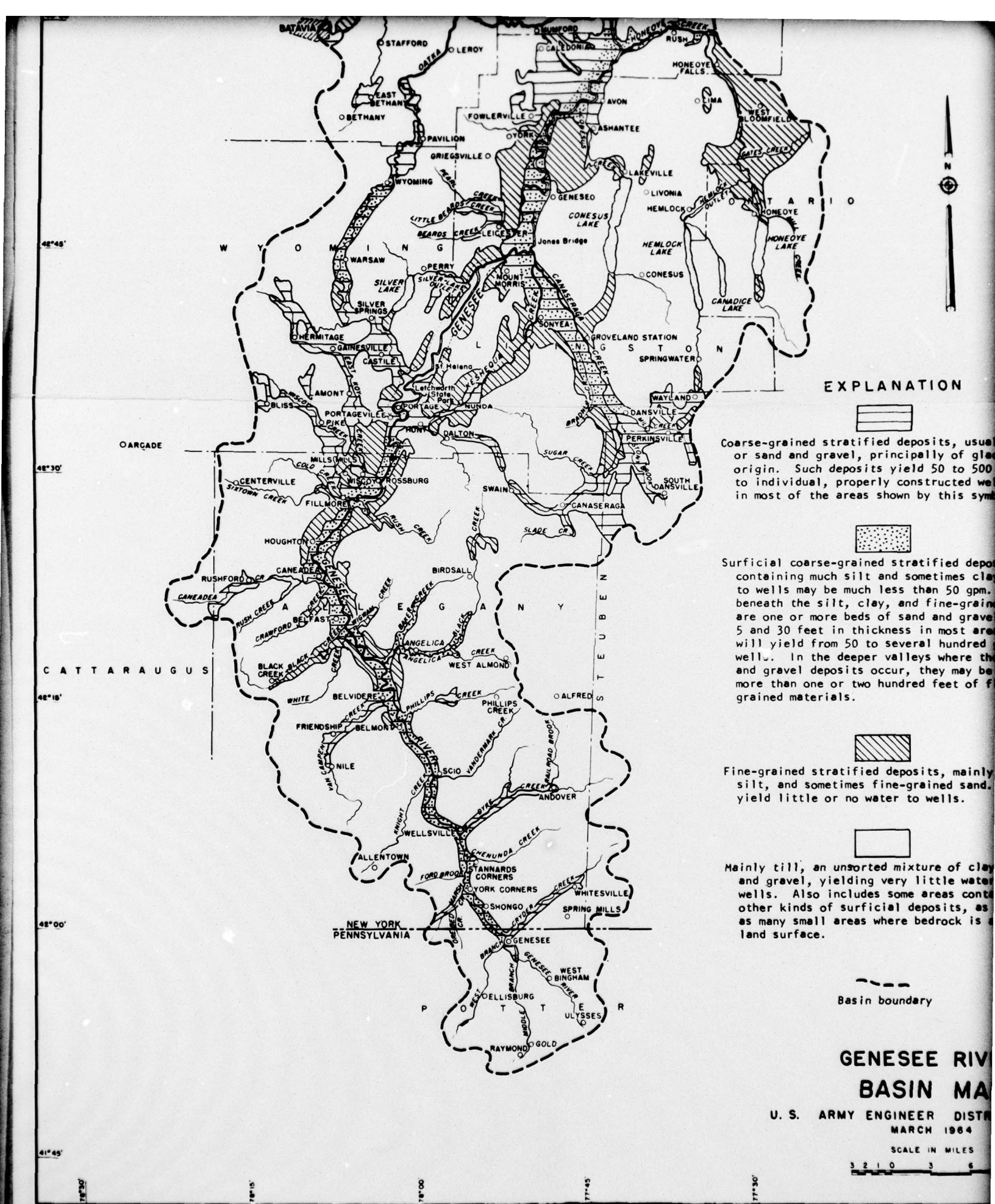
ANDOVER

EXPLANATION

Coarse-grained stratified deposits, usually sand or sand and gravel, principally of glacial origin. Such deposits yield 50 to 500 gpm to individual, properly constructed wells in most of the areas shown by this symbol.

Surficial coarse-grained stratified deposits also containing much silt and sometimes clay. Yields to wells may be much less than 50 gpm. However, beneath the silt, clay, and fine-grained sand are one or more beds of sand and gravel between 5 and 30 feet in thickness in most areas which will yield from 50 to several hundred gpm to wells. In the deeper valleys where these sand and gravel deposits occur, they may be beneath more than one or two hundred feet of fine-grained materials.

Fine-grained stratified deposits, mainly clay and silt, and sometimes fine-grained sand. Commonly yield little or no water to wells.



EXPLANATION

Coarse-grained stratified deposits, usual
or sand and gravel, principally of gla
origin. Such deposits yield 50 to 500
to individual, properly constructed we
in most of the areas shown by this sym

Surficial coarse-grained stratified depo
containing much silt and sometimes cla
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beneath the silt, clay, and fine-grain
are one or more beds of sand and grave
5 and 30 feet in thickness in most are
will yield from 50 to several hundred
wells. In the deeper valleys where th
and gravel deposits occur, they may be
more than one or two hundred feet of f
grained materials.

Fine-grained stratified deposits, mainly
silt, and sometimes fine-grained sand.
yield little or no water to wells.

Mainly till, an unsorted mixture of cla
and gravel, yielding very little wate
wells. Also includes some areas conta
other kinds of surficial deposits, as
as many small areas where bedrock is
land surface.

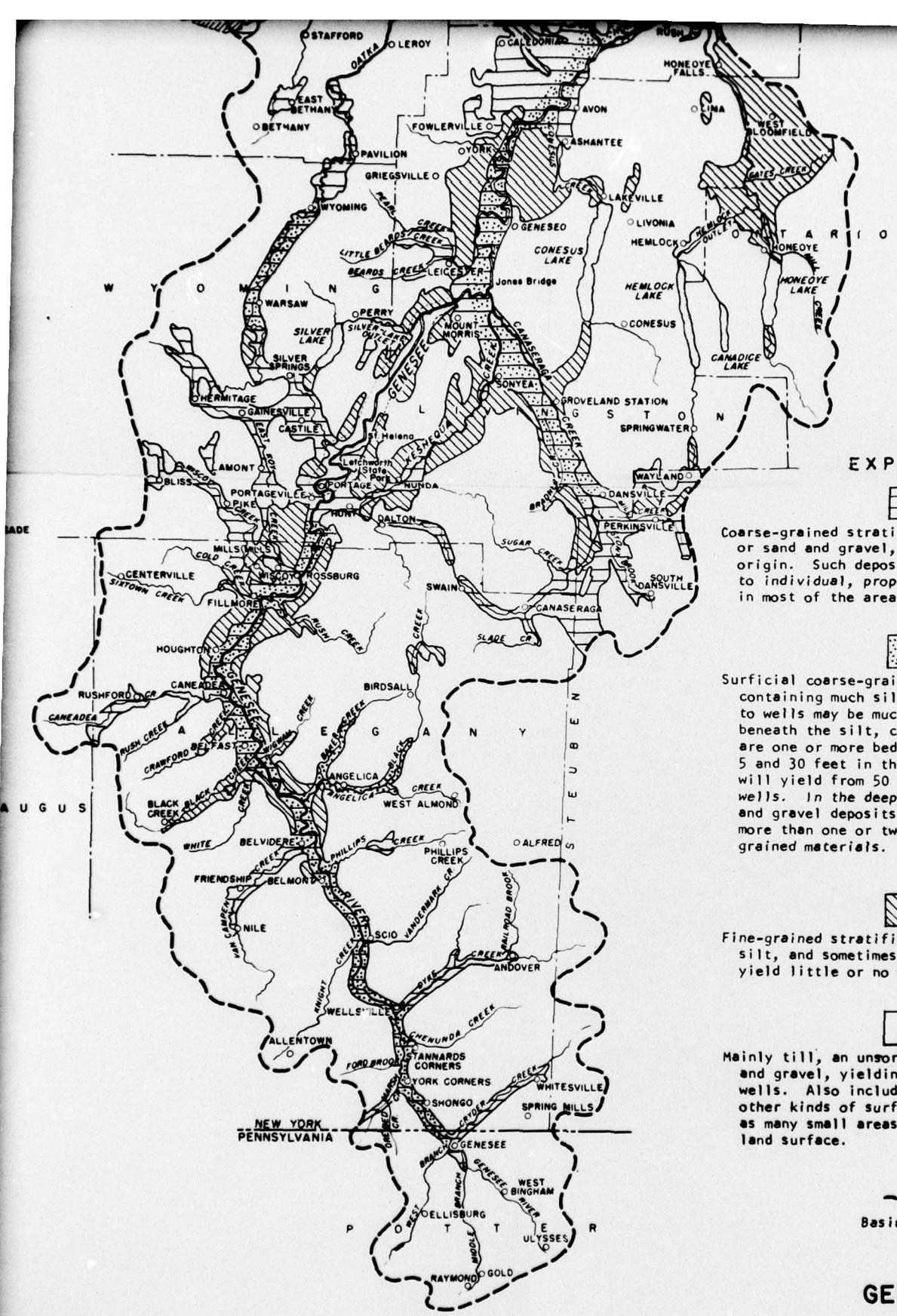
Basin boundary

GENESEE RIV
BASIN MA

U. S. ARMY ENGINEER DISTR
MARCH 1964

SCALE IN MILES
3 2 1 0 3 6

Map of surficial deposits of the Genesee River basin, N. Y.



o of surficial deposits of the Genesee River basin, N. Y.-PA.